The Electrical World.

VOL. XXVIII. NEW YORK, AUGUST 15, 1896. No. 7.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,
in the United States, Canada or Mexico; other foreign countries, $6

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THE ELECTRICAL WORLD,

253 Broadway, New York.

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INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE.

In looking over the resolutions adopted by the Conference on an International Catalogue of Scientific Literature, organized by the Royal Society, we are pleased to note a similarity between the ideas expressed pertaining to the method of indexing and those which have been adopted in the *Digest* of THE ELECTRICAL WORLD. The catalogue, as contemplated, will be devoted to original contributions to pure science, to the exclusion of the applied sciences, and will contain not merely an index according to the subject matter of the articles appearing in periodicals or in the publications of societies, or as independent pamphlets, memoirs or books, but regard will also be had to the nature of the contents. The index will be arranged according to the subject matter as well as the author's name, as distinguished from alphabetical classification. The administration of the catalogue will be under the charge of an "International Council," while the editing and publication will be entrusted to a "Central International Bureau," the same to be under the direction of the council. The system of collecting and preparing material in each country will be subject to the approval of the council and matters inserted in the catalogue will be irrespective of the source of publication. It is left to the discretion of the council to decide upon the nature of the matter which shall be entered. English will be the language used, the titles and authors' names only appearing in the original language, unless otherwise decided by the council. Jan. 1, 1900, was fixed by the conference as the date of beginning the catalogue. The work accomplished under the general plans which the conference has laid out promises to form the basis for the most extensive and valuable index of scientific literature ever undertaken, a fact which will be highly appreciated by those devoted to scientific study. A substantial financial backing is all that is still wanting to make this worthy enterprise a success.

ARC LIGHTING STATISTICS.

A preliminary report of the National Electric Light Association on arc lighting statistics, embracing about 400 cities and towns of the United States having a population of 5,000 or more, has just been issued, and gives for each locality the number of arcs, candle power of each, price per night, and the time of burning. In glancing over the report we notice a wide variation in the cost of street lighting, one municipal plant reporting a cost of $36 per year for 1200-cp lamps burning seven hours per night under a moonlight schedule, while the price paid in one of the largest cities is $182.50 per year for the same candle-power arcs burning all night. A second city contract was let for a period of five years for one hundred and thirty 1200-cp arcs burning until midnight at $36 per arc per annum. The report shows that the rates in four municipalities are above $180 per annum, while in one muncipality above $170; in five above $160; in six above $150; in nine above $140; in 10 above $130; in 31 above $120; in 28 above $110; in 58 above $100; in 73 above $90; in 61 above $80; in 64 above $70; in 34 above $60; in 14 above $50 and in nine above $40. Of the 33 municipal plants mentioned, 10 failed to report, and of the remaining 23 which reported, the cost for nine ranges from $50 for 1500-cp arcs to $96 for 2000-cp arcs, burning all night, and for the remaining 14 from $36 for 1200-cp arcs to $70 for 2000-cp arcs burning on a moonlight schedule. A supplementary report covering the cities and towns which have been omitted in the preliminary report will soon be issued to the members.

Although the conditions under which each plant is operated are not stated in the report before us, and therefore the fundamental causes for such wide variations in the cost of municipal lighting are not evident, the names of the cities are in each case given, and the members of the National Electric Light Association will doubtless find the work thus far accomplished a valuable source of information and one which each member may doubtless extend through correspondence.

EFFICIENCY FACTORS.

A second communication from Mr. Bláthy, "On the Dissipation of Energy Caused by the Armature Currents in Electrical Machinery," which appears in another column of this issue, gives a summary of the data which the author has obtained relative to a 44-kw direct-current dynamo. The method of testing was that devised by Dr. Hopkinson some 10 years ago and afterward modified by Mr. Kapp. The author states that the "load loss" is nearly proportional to the square of the armature current, directly proportional to the speed and practically independent of the field strength. The matter is, however, not presented in a form which materially aids the reader in judging the real merits contained in this newly discovered source of energy dissipation in the armatures of dynamo-electric machines. Dr. Hopkinson showed in the same paper, in which the modified method of testing employed by Mr. Bláthy was at the same time described, that the losses at full load may be considerably less than those at a fraction of the full load, and that instead of requiring more energy to drive a dynamo under the former case the energy required was actually less as the external load increased. Good examples of this nature were to be found in some of the early types of solid-core arc-lighting machines, facts which were duly noted but for a long time remained unexplained. It is highly probable that notwithstanding the fact that Mr. Bláthy has experimented upon a most recent design of dynamo, that in a large majority of the modern types the total of all losses will increase with an increase of load. Mr. Bláthy finds that the load loss, equal to $(c-1)\ RI^2$, increases, but in a manner apparently totally different from that hitherto observed. We have always been accustomed to include in the total losses in the armature of the dynamo, first, loss due to hysteresis, which loss varies directly as the speed and as the 1.6 power of the induction; second, the eddy current loss which varies as the square of the speed and also as the square of the induction; and, third, the RI^2 or heat loss. The load loss as defined above is a factor of the heat loss, and according to the results obtained by Mr. Bláthy varies as the 1.75 power of the current, and at a somewhat greater rate than the first power of the frequency of reversal, but is little influenced by the magnetic field strength. We trust that, under the light of future investigations, the points which now remain obscure in these interesting results will be cleared up by those devoted to this line of work.

HYPOTHESES AND FACTS.

Were some English writers to fulfill the functions of an electrical dictionary we fear that many of the present terms and phrases defining electrical phenomena would undergo a most remarkable transition. At least this is the impression one is apt to form after having perused the long series of articles on the subject of "negative resistance," for inasmuch as no one has for a moment questioned the experiments performed by the authors of this inadvisedly selected term, the only apparent basis for the controversy has been the fact that at present no term exists which adequately expresses the observed phenomenon. It is not improbable that had some of the negative-resistance advocates early experimented with synchronous alternating-current motors under certain conditions of load, we should have been informed that because the motor E. M. F. was much greater than that of the generator, the new property had been discovered that in copper under these conditions there existed a negative resistance. The analogy differs only in the fact that concerning the motor most of its properties are known, whereas in the arc little can be stated with certainty. Not the least humorous of the remarks which we have observed during this controversy is that for personal use Mr. Oliver Heaviside prefers gas, evidently a quantity, to Mr. Heaviside's way of thinking, having a direct bearing upon the subject under discussion. We do not hesitate to admit, however, that we have reviewed the articles published with a great deal of interest. We revert with more confidence to statements almost as startling, but possessing a more substantial basis, being the results of experiments carried out by Dr. Fleming and Prof. Dewar and contained in a paper by the former, read at the Royal Institution and concluded elsewhere in this issue. It was found, for instance, that iron at—186 degrees C. has a conductivity 30 per cent. better than copper at 15 degrees C. Alloys on the other hand undergo but a slight change in resistance when cooled. The resistance of pure metals apparently vanishes at the temperature of absolute zero, which is equivalent to saying that an indefinitely large amount of electrical energy could be transmitted over an exceedingly small wire without loss. At the same time pure metals would fulfill the laws of perfect conductors, that is, act as magnetic screens and therefore not be penetrated by electrical currents. The peculiar properties exhibited by bismuth are no less remarkable, especially the reversal effects after cooling, produced by a magnetic field. The paper is a most important contribution to electrical science, and one which, together with others promised, will be a valuable aid in clearing up the many obscure notions now held regarding molecular physics.

The Rapid Transit Problem in New York.

At the meeting of the Rapid Transit Commission on Aug. 6 the plan for extending the elevated railway system, which was proposed by Mr. George J. Gould, and which was outlined in The Electrical World of July 25, was rejected, for the reason, as declared by the Commission, that it had no power to authorize the Manhattan Elevated Railway Company to build a surface road, as was proposed in the Gould plans.

A new proposition was brought before the Commission, and it met with the approval of Commissioners Orr, Claflin and Steinway. This proposition is embodied in the following resolution, which was adopted:

Resolved, That the chief engineer be and he hereby is directed to submit to this Board at as early a date as possible, routes and a general plan of rapid transit which shall conform to the following conditions:

First: Total cost after abundant allowance for contingencies not to exceed $30,000,000.

Second: Route to proceed from the southern terminus at or near the Post Office, and under the City Hall Park and Park Row to Elm Street, and Fourth Avenue to or near the Grand Central Station, and there to divide into an east and west side route. The west side route to proceed under Forty-second Street to Broadway and the Boulevard to a point above 125th Street. The east side route to proceed under Park Avenue and over private property to the Harlem River, and across and beyond the Harlem River to as distant a point as the proposed limit of cost will permit.

Third: The railway to have four tracks to the junction of the east and west side routes, and above that point two tracks on each route, except that a third track for express service shall be added on both routes when conveniently and economically possible.

Fourth: The road to be in tunnel except on the east side north of Ninety-eighth Street, and on the west side at Manhattanville, 125th Street.

Fifth: Plans to be so drawn as to permit further extensions in the future from the south and north termini, and permitting the two and three track portions to be widened into a four-track system without unnecessary expense or interruption of traffic.

A Submarine Torpedo Boat.

There is now under process of construction in the yard of the Columbia Iron Works at Baltimore, a submarine torpedo boat, which is likely to rival the visions of Jules Verne. It is expected that this craft, which will be launched in September, will be able to maintain a speed of eight or nine knots per hour when submerged to a depth of 60 feet. A correspondent to the New York *Sun* states that the motive power consists of a boiler heated by petroleum, supplying steam to three triple-expansion engines, each driving a propeller and capable of developing 1800 horse-power, a generator set and a battery of accumulators. When the vessel is about to go under water the smoke stack is housed and the top covered over. The engines will be kept at full speed, and by turning the rudder she submerges to the desired depth. The speed is afterward maintained by the dynamos running as motors and supplied by the accumulators which were previously charged. It is expected that the battery will enable the craft to maintain a speed of 12 knots per hour for short distances. The fighting tube will be the only part visible when the boat comes near the surface. This contains a telescope and prism at the top, and enables the maintaining of the proper course. As the prism is fully protected by Harveyized nickel steel armor, it is not likely to suffer much injury due to an occasional stray shot.

Air for the crew, which will consist of about 12 men, four officers and eight seamen and machinists, will be stowed in reservoirs and may be replenished by a pump connected to a rubber tube terminating in a float on the surface of the water. The armament will consist of two torpedo tubes, one forward and one aft, which will discharge automobile torpedoes. Should all of the driving machinery fail, she can remain below for an indefinite time. Water ballast will be used, thus enabling the maximum depth desired to be attained, but automatically controlled to prevent an excessive submergence.

Processes for the Nickel Plating of Wood.

It may strike most readers as rather peculiar that an industry for the nickel plating of wood has developed quite extensively in Germany, and that this product may be employed for a great variety of purposes. Of the several processes now in vogue those mentioned by the London *Electrical Review*, in an abstract from Dingler's *Polytechnisches Journal*, 298, may prove of interest. First of all the articles which are to be plated with nickel must be coated with metal. In the process which is most commonly employed, three solutions are made use of, namely, (*a*) 1½ grms of caoutchouc slicings are dissolved in 10 grms of carbon bisulphide, and 4 grms of melted wax are poured into the solution; a mixture consisting of 5 grms phosphorus in 60 grms of carbon bisulphide, with 5 grms of turpentine and 4 grms of powdered asphalt is then added and the whole shaken. (*b*) 2 grms of silver nitrate are dissolved in 600 grms of water. (*c*) 10 grms of chloride of gold are dissolved in 600 grms of water. The conducting wires are attached to the article, which, after being immersed in the first solution, is allowed to dry. The second solution is poured over it, and it is kept suspended until the surface has a dark lustre, when it is rinsed with water and treated in a similar manner with the third solution. The surface has now a yellowish sheen, and the wood is sufficiently prepared for electrolytic deposition. Langbein's dry process consists in quickly pouring over the article a collodion solution of potassium iodide, diluted with an equal volume of ether-alcohol; when the layer is just about to set, the wood is laid in a weak solution of silver nitrate, light being excluded. As soon as a yellow color appears, the wood is rinsed, exposed to sunlight and covered with copper; it is then ready to be nickel-plated. The wood may also be treated with immersion in an ethereal solution of paraffin or wax, and when the ether has evaporated, fine graphite is powdered over them, or the wax is covered with bronze powder and all unevenness of surface removed. When the articles are to be electrolytically coated with copper they are placed in a bath, the composition of which varies with the current employed generally; it consists of 30 litres of 18 per cent. copper sulphate solution, and 1½ litres of 66 per cent. sulphuric acid. When a sufficient amount of copper is deposited the articles are ground, polished and nickel-plated in a bath composed of 500 grms of ammonium nickelous sulphate, 50 grms of ammonium sulphate, and 10 litres of distilled water. If the blue litmus paper be quickly reddened by this solution, the acidity is reduced to such a point by addition of ammonium chloride that the reddening is only slowly developed.

The Berliner Microphone Patent and the Law.

BY F. F. FROST.

A careful study of the Berliner 1891 microphone patent necessitates its division into two parts, namely, the specification and the claims.

Discussing the specification, we may well ask ourselves what it specifies. It is of course supposed to describe his invention or discovery. Was this patent for a discovery or was it for an invention, or both? Without going back of the patent as issued, let us discuss this point. Did Berliner discover the microphonic transmission of speech? No, nor does he claim it. Did he discover the method of the microphonic transmission of speech? This he claims, and for this his patent was granted. The difference between the discovery of the microphonic transmission of speech and the discovery of the method of the microphonic transmission of speech is wide. It is clear that others before Berliner had discovered the microphonic transmission of speech, but were ignorant of the conditions necessary to its accomplishment. This has been the contention of the American Bell Telephone Company in every instance. It is also their contention that Berliner discovered the conditions necessary to the microphonic transmission of speech, and the fulfilment of these conditions constitutes his method.

Berliner invented a mechanism which consisted of a diaphragm constituting one electrode, against which was placed another electrode. The sound-waves in air in actuating the diaphragm modified the resistance between the two electrodes. But in order that this mechanism might transmit speech, he found it necessary that constant contact should be maintained between the electrodes, the change in resistance being due to the change in pressure between them while in constant contact. He furthermore found that when constant contact between the two electrodes was not maintained speech could not be transmitted. In other words, he found that when the two electrodes were maintained in constant contact the instrument was operative, and when not maintained in constant contact that it was inoperative.

Now I submit that this necesssary maintenance of constant contact between the electrodes is a portion of the operation of the mechanism in exactly the same way that in a watch it is necessary to maintain the constant enmeshment of the tooth-wheels and pinions for its operation; for if such constant enmeshment were not maintained, it is clear that the motion of one part could not be continuously transferred to another part. Nor does this maintenance of constant contact consist of aught else than solely the operation of the machine.

Now let us look at Berliner's first claim. It reads: "The method of producing in a circuit electrical undulations similar in form to sound-waves by causing the sound-waves to vary the pressure between electrodes in constant contact and thereby increase and diminish the resistance of the circuit substantially as described."

If this language be reduced to its simplest terms, it becomes the transmission of speech by varying the pressure between electrodes in constant contact. In other words, the transmission of speech by operating the mechanism described.

In the decision of the case Risdon Iron & Locomotive Works *vs.* Medart, *et al.*, decided April 22, 1895, by the United States Supreme Court, is the following: "It is equally clear, however, that a patent cannot be obtained for a process which involves nothing more than the operation of a piece of mechanism or, in other words, for the function of a machine."

It is equally clear that there is nothing more involved in the Berliner microphone than the operation of its mechanism, or in other words, its function is to operate with its electrodes in constant contact.

Therefore, Berliner was not entitled to the patent for the function of his mechanism, and therefore the first claim is clearly void.

The second claim reads thus: "An electric speaking telephone transmitter operated by sound-waves and consisting of a plate sensitive to said sound-waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy and adapted to increase and decrease the resistance of the electric circuit by the variation of pressure between them caused by the vibrational movement of said sensitive plate."

The language, "electrodes in constant contact . . . adapted" to do a certain thing, is wholly within the above argument, and the claim becomes one for a mechanism adapted to perform its work, and is clearly for its function.

Therefore this second claim is invalid.

All that remains of the second claim, then, is that which refers to the bare construction of the instrument. It consists of a plate sensitive to sound-waves, electrodes in contact with each other and forming part of a circuit which includes a battery or other source of electric energy. All this had been done before and was not new, and was not Berliner's.

If we take from the Berliner patent all that is not his, what is there left? Let us do this and note how glaringly absurd is his claim.

First: The plate sensitive to sound-waves! This must come out, for it is as old as science. Second: Electrodes in contact! These, too, must go by the board. Third: Electrodes forming a part of a circuit which includes a battery or other source of electric energy! This must also be discarded. "Constant" alone is left. He claims *constancy* in his machine! He claims a certain *maintenance* in it!

In the decision of the United States Supreme Court in the case above cited it was its sense that there was no process or method involved in an operation unless there was some chemical or elemental change produced, even though mechanism might be necessary to such change. The physical operation of a mechanism, however, was no process or method. When elemental change did take place the process or method was patentable, but not the physical operation.

Berliner might contend that his method involved an elemental change in the undulating of an electric current, but that was not his discovery. He merely *utilized* the physical fact that two bodies could be made to constantly remain in contact with each other, which physical fact was the function of the instrument for bringing about the elemental change.

On the Dissipation of Energy Caused by the Armature Currents in Electrical Machinery.

BY OTTO T. BLATHY.

During the last two weeks I have had occasion to investigate the load losses in a certain type of dynamo machine, the results of which, together with a few conclusions, are as follows:

Two identical direct-current machines, type C 40, of Ganz & Co. were coupled together, one being used as a motor, the other as a generator. The characteristic features of these machines are:

Type C 40, nominally for 110 volts and 400 amperes at 450 revolutions; has six poles, each of which embraces 185 mm of the periphery. Outer diameter of armature, 500 mm; inner diameter, 300 mm; axial length, 400 mm. Bore of field magnets, 512 mm. The armature has 96 slots, each 30 mm deep and 7½ mm in breadth, each slot containing four wires of 5.6 mm; 32 coils give 110 volts; complete symmetrical winding; 96 sectors in the commutator.

The resistance of the armature at 27 degrees C. is 0.006 ohm.

Resistance of the shunt, 19 ohms.

Maximum exciting current, 4.2 amperes. At 450 revolutions, 110 volts and 405 amperes in the armature, the working losses are distributed in the following manner:

Friction and air resistance	730	watts
Hysteresis and eddy currents (running free)	880	"
Exciting energy at 4.2 amperes	460	"
Armature loss due to ohmic resistance	985	"
Load loss	740	"

This dynamo gives an efficiency at a full load of 92 per cent., while omitting the load loss 93.5 per cent. would be obtained.

A series of experiments were made upon this machine to determine the dependence of the load loss on the strength of the armature current, on the number of revolutions and on the field strength. One machine was used as a motor, the other short circuited and only weakly excited, sufficient to maintain an adequate current in the short-circuited armature. In the second set of experiments the two armatures were connected in series and one used as a motor, the other as a dynamo with equal current, consuming energy supplied to a third dynamo having its armature likewise connected in the circuit of two machines after the plan first suggested by Dr. Hopkinson. In this manner the working loss was directly measured and is with far greater accuracy determined than if one measured the whole of the energy supplied to the motor by the dynamo. By this method it is only necessary to consider the average of the potential difference at the dynamo and motor, 110 volts. The appended table gives from among a large number of experiments the probable mean values. An inspection of the table shows that the load loss is nearly proportional to the square of the armature current; under otherwise simular conditions, it is nearly proportional to the speed of the machine with small as well as normal field strength. That the load loss with short circuit, therefore small field strength, is really greater than with normal potential and therefore a strong field.

These results also permit of a conjecture as to the expression relative to the nature of the load loss. The same appears as work of demagnetizing the iron; that is the amount of work due to Foucault currents and hysteresis; this quantity increases almost as the 1.75 power of the current and at a rate somewhat greater than the number of pole reversals, but would be naturally smaller in a magnetized body of iron subjected to other influences (here the strength of the magnetic field of the machine) than if the armature currents by which the losses are produced are in full effect.

Number Revolutions Per min.	Armature Current	$R I^2$ Armature Loss.	Load Loss.	Load Loss. $R I^2$	Remarks.
154	410	1040	350	0.34	Armature Short Circuited.
136	590	2150	1050	0.49	
280	410	1020	760	0.74	
287	570	2000	1500	0.75	
455	400	960	1140	1.19	
446	570	2000	2300	1 15	
540	410	1050	1450	1.38	
590	590	2180	2970	1.36	
266	422	1070	460	0.43	At 110 Volts.
345	395	940	550	0.58	
468	375	850	660	0.78	

$R I^2$ is calculated with a consideration of the small variation of R, due to temperature variations.

President's Interim Report to the National Electric Light Association.

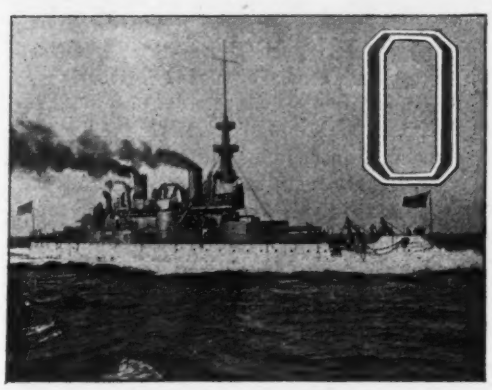
In an interim report to the members of the National Electric Light Association, President Nicholls states that he has endeavored since the last annual meeting to initiate, and with the assistance of the secretary, to conclude certain matters upon which he reports as follows:

At the last convention the Committee on Relations between Manufacturing and Central Station Companies was discharged, and the Executive Committee authorized to take such action as might, from time to time, be found necessary, in an endeavor to protect its active members from having their investments in central station companies destroyed or seriously impaired, as a result of ruinous competition, directed or fostered by the manufacturing companies. A case arose in a Western town, the president states, which justified prompt and energetic action on the part of the association. After consultation with the members of the Executive Committee he placed the views of the association as to this particular case, and as to unwise and unwarranted competition in general, before the executive officers of the following manufacturing companies: Ball Electric Light Company, Brush Electric Company, Fort Wayne Electric Corporation, General Electric Company, Royal Electric Company, of Peoria; Siemens & Halske Electric Company, Stanley Electric Manufacturing Company, Western Electric Company, Westinghouse Electric & Manufacturing Company.

The details of the negotiations resulted favorably, and with the exception of the Ball Electric Light Company, satisfactory assurances were received regarding not only the particular case in question, but also as to the future general policy of the companies. Should, however, any active member have reasonable cause for complaint, he should forward full corroborative details to the secretary and the association will take prompt and energetic measures, if the circumstances warrant such action. Being aware that no recent and reliable statistics of the cost of arc lighting in the cities and towns were available for use by members of the association, the president some time since instituted correspondence with the municipal authorities of each city and town in the United States, with the object of securing from official sources and by official authority reliable information from each place as to (1) the number of arc lamps, (2) their candle-power, (3) the hours of burning, (4) the cost per lamp per night. A preliminary bulletin has been published containing such information from over 400 cities and towns, which list covers a very large majority of the principal installations. A supplementary list, containing similar information in regard to places now omitted, is in process of compilation.

Correspondence has been entered into with the Secretaries of State for each of the States in the Union, with a view to making arrangements to have regularly forwarded to the association copies of all bills introduced in any State that may deal with the rights of electrical companies. The president reports that a large majority of the States have acceded to the request, and several have already forwarded copies of all bills passed during the past session of their Legislature, while others have promised to forward any that may be introduced during future sessions.

Some Electrical Features of the United States Battleship "Indiana."



OF the several heavy-armored battleships of the United States Navy, the *Indiana* is the most formidable, and in her design and equipment presents to the electrical as well as naval engineer the greatest interest. This ship, the mightiest of Uncle Sam's fleet, and capable of coping with any vessel afloat, was placed in commission on Nov. 20, 1895. She is 348 feet long, 69 feet 3 inches in breadth, has a draft of 24 feet and a displacement of 10,288 tons. She is provided with twin screws, each operated by triple-expansion engines, and which are capable of driving her at a speed of 16 knots per hour.

The main battery of breech-loading rifles consists of four 13-inch, carried in two turrets, one forward, the other aft, eight 8-inch mounted within four turrets situated at the four quarters of the ship and four 6 inch. When it is remembered that each inch in the diameter of bore represents a power to throw a projectile one mile, it will be better appreciated what such a battery as this means. To fire each 13-inch gun once costs $700, a figure which is rapidly multiplied when target practice is indulged in during an extended cruise. Each discharge of the 13-inch rifles produces a reacting pressure at the breech of 2¼ tons per square inch and a recoil of about four feet. The secondary battery consists of 20 6-pounder and six 1-pounder rapid-fire guns and four Gatlings. The thickness of the armor is 18 inches and is of Harveyized nickel-steel. Thirty-six officers and 434 men constitute the crew, the commander being Robley D. Evans.

This magnificent specimen of naval architecture, an entirely American product, was built for the United States Navy at a cost of $3,020,000, by the Wm. Cramp & Sons Ship & Engine Building Company, Philadelphia. Of greater interest to the reader is the electrical equipment which constitutes the basis for this article.

Mounting to the bridge on the mast, we find there installed two 24-inch projectors or searchlights, one on the starboard, the other on the port side, each being furnished with an electrical control-stand, consisting of two small motors, one permitting of lateral train, the other of vertical. These motors are operated from a small platform above the bridge. The lights are rated at 20,000 candle-power and

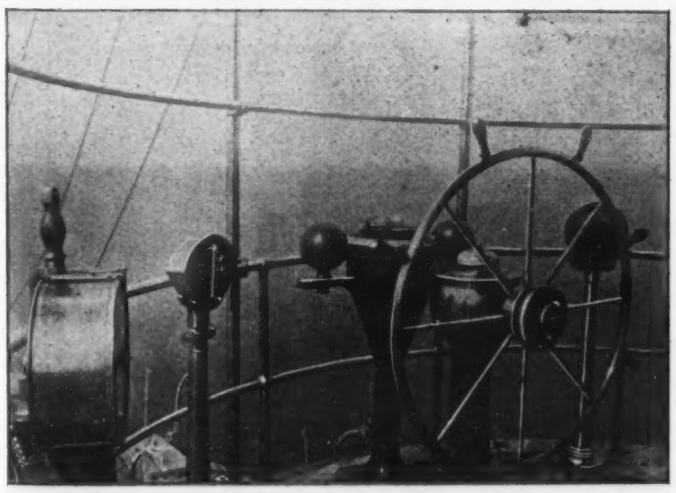


FIG. 1.—BRIDGE.

have horizontal carbons placed perpendicular to the Mangen or parabolic reflector according to which each is provided. The positive carbon, which is soft-cored and larger in diameter than the negative, has its crater toward the reflecting mirror. A small disc metal reflector perpendicular to and over the positive carbon also aids in reflecting scattered rays to the larger mirror. Two similar projectors are placed on the bridge deck aft and are operated from a platform under the bridge deck. Each projector is supplied with a Weston volt and ammeter as well as a rheostat, which are located in the dynamo room in a convenient position for the man in charge to handle. To the right of the bridge helm, shown in the illustration, Fig. 1, will be noticed an instrument called the helm indicator, forming a part of the Fiske system of ship-telegraphs. It indicates the position of the helm at any instant, and is in principle merely a galvanometer, having its zero point in the central vertical position, and connected in parallel with a circuit such as shown in Fig. 2. Rigidly fastened to the rudder-post is a strip of resistance wire through

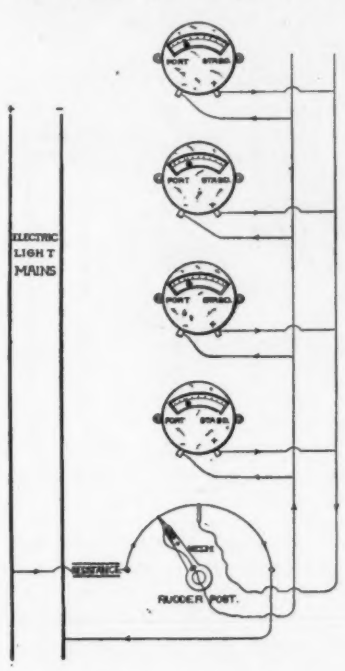


FIG. 2.—CONNECTIONS FOR HELM INDICATOR.

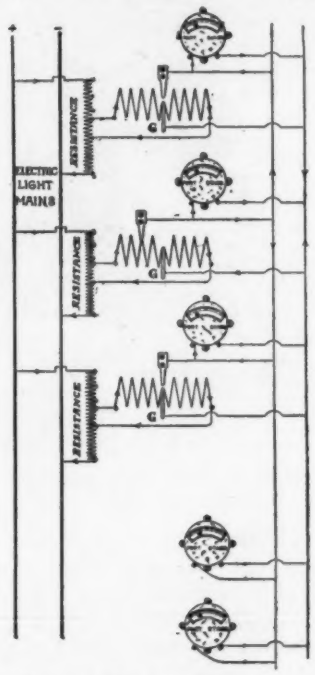


FIG. 3.—CONNECTIONS FOR STEERING TELEGRAPH.

which a current continually passes produced by a drop across a resistance in the main lighting circuit. As the rudder moves, a contact simultaneously slides over this resistance which cuts in or out more or less of it, and therefore produces a corresponding change in the difference of potential at each indicator. These indicators are placed in various parts of the ship, and are illuminated each by a small incandescent lamp.

Directly in front of the bridge helm is the compass, of the navy

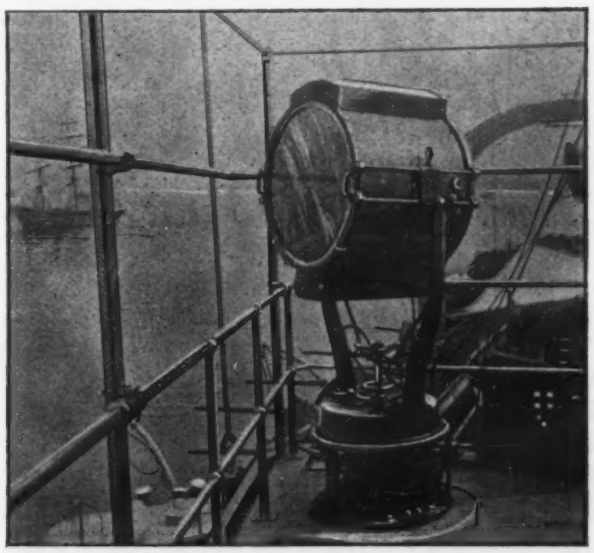


FIG. 4.—SEARCHLIGHT.

ordinance pattern, and to the left of this, in Fig. 1, is the steering telegraph, the function of which is to telegraph to the steering wheels the position at which the officer in charge desires to have the helm placed. This transmitter, which is but one of several, is electrically connected to indicators secured in conspicuous positions

near the steering wheels and operated upon the same principle as the helm indicator just described. A diagram of the connections is shown in Fig. 3, where *G* represents the transmitters which are located on the bridge, directly under the bridge in the pilot house and directly under the pilot house and within the mast, called the conning tower. In fact the entire management of the ship can be controlled from either of these positions, the latter, which is heavily armored, being used only in practice or an engagement. The movable contact of the transmitter *G* does not touch when in the central position, in which position it remains when not being used, so that any transmitter is independent of the others and may be used at any time.

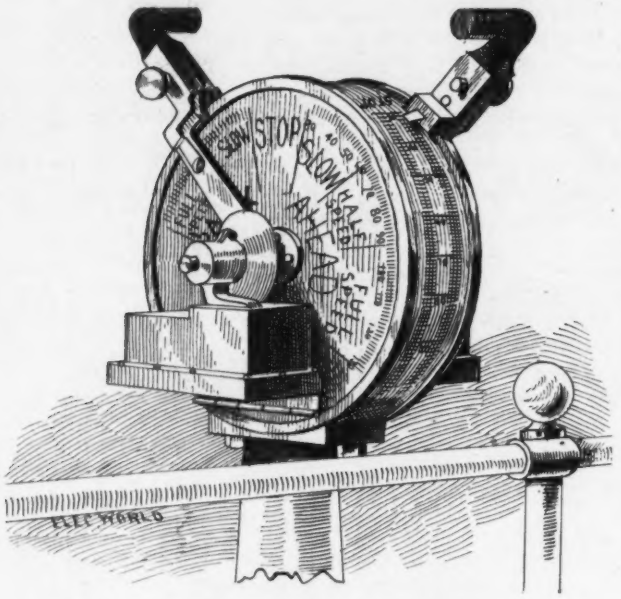


Fig. 5.—Engine Telegraph Transformer.

After the command has been given to set the helm at a certain position indicated by all of the steering indicators, the precision with which the man at the helm obeys is immediately recorded by a helm indicator placed near the former.

Fastened to the mast a few feet above the bridge is a speed and direction indicator having a port and starboard needle, which are respectively operated by the port and starboard engine shafts. This indicator is for the purpose of telling in which direction the shafts

Fig. 6.—Engine Telegraph Receiver.

are turning, and with the aid of a watch the number of revolutions may be determined. In principle the indicator is exceedingly simple, being merely a polarized relay. It is operated by a toothed eccentric strap fastened to the shaft and rolling, on which is a small tooth roller. As the shaft turns the roller is shifted slightly, depending upon the direction of rotation, and at the same time raises at each turn a contact point which makes contact at either the right or left, thereby determining the direction of the current through the indicator at the bridge.

Another and far more important instrument to be found on the bridge is the Fiske engine telegraph. The function of this instrument is to signal to the engine-room the desired speed and direction of the engines. Each engine has its transmitter and receiver, the transmitters being in one instrument (Fig. 5) and one receiver (Fig. 6) in each engine room. The telegraph is operated on the Wheatstone bridge principle, as shown in Figs. 7 and 9. Both the transmitter and receiver have equal resistances arranged in an arc of a circle. The zero position of each instrument is vertical. It follows therefore that if the transmitter handle be moved over a given arc, it will be necessary, in order to balance the bridge, to move the receiver handle a corresponding amount. In series, with both the receiver and transmitter, are galvanometers, that on the former being a Weston instrument. After the transmitter handle has been thrown over, both galvanometers will deflect and will continue to do so until balanced at the receiver. Thus the officer giving the command knows immediately if his order has been received. The Weston instrument, placed on the receiver, moves with the handle, and inasmuch as the needle is not balanced for all positions, it is necessary to have a second stationary galvanometer, shown at g', Fig. 9, to make more exact adjustments. This is done by shifting the handle and tapping the key *K*. Moving the arm of the transmitter over a very small arc automatically rings a 10-inch gong located in the engine room, thereby attracting the engineer's attention.

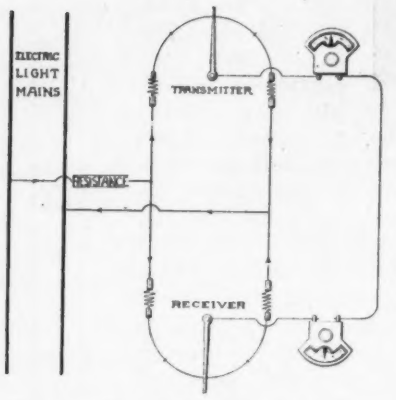


Fig. 7.—Engine Telegraph Circuit.

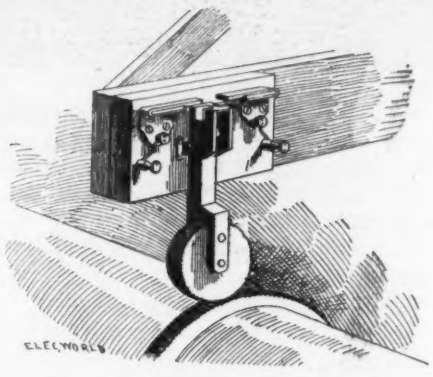


Fig. 8.—Shaft Contact Device.

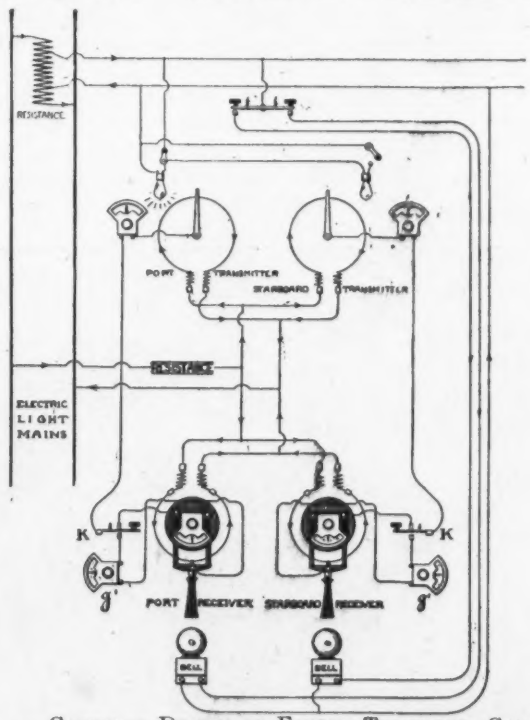


Fig. 9.—Complete Design of Engine Telegraph Circuits.

It will be seen in Fig. 5 that the engine telegraph has two handles. The two sides are duplicated and transmit respective orders to the port and starboard engine rooms. Placed at each side is a small one-cp lamp to illuminate the faces at night. The whole system is operated by taking a drop across the lighting mains. The gradua-

tions on both the receiver and transmitter correspond to revolutions per minute.

There are two systems of night signaling used in conjunction with the electric lighting system. The truck light consists of a double lantern placed at the top of the mast, the upper half of the lantern being red, the lower white, in each half of which an incandescent lamp is placed. These lights are operated separately or together by means of a pulsating switch situated on the forward part of the

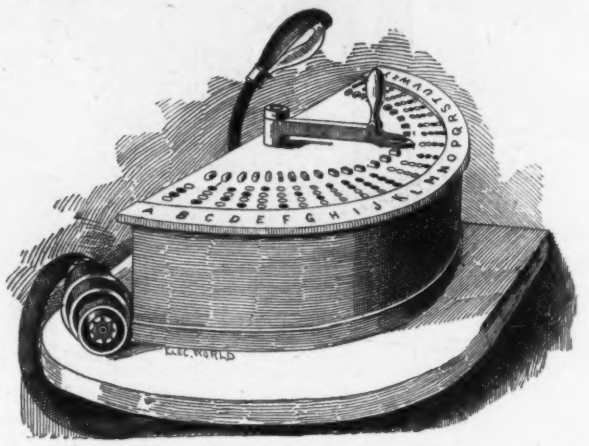


FIG. 10.—KEYBOARD.

mast on the top of the pilot house. This signal is for the admiral's usein squadron evolution.

The second is called the Ardois signaling set, and is composed of four double lanterns, upper red, lower white, having Fresnel lenses. These lanterns are suspended by two wire jack-stays with connecting cross-arms, from the centre of which the lanterns hang, spaced 10 feet apart The upper end of the jack-stays is secured aloft to a stay, and the lower end sets up with two turnbuckles, one on each leg. There is a cable containing a wire for each lamp with a common return, which is connected electrically to a keyboard (Fig. 10). The face of the board is divided into sections ; each one of these sections is marked with the number and order in which the lanterns will burn when the key is moved to this section. These sections designate numerals, letters or sentences. By this system it is possible to form 64 combinations. The type of lantern used is shown in Fig. 12.

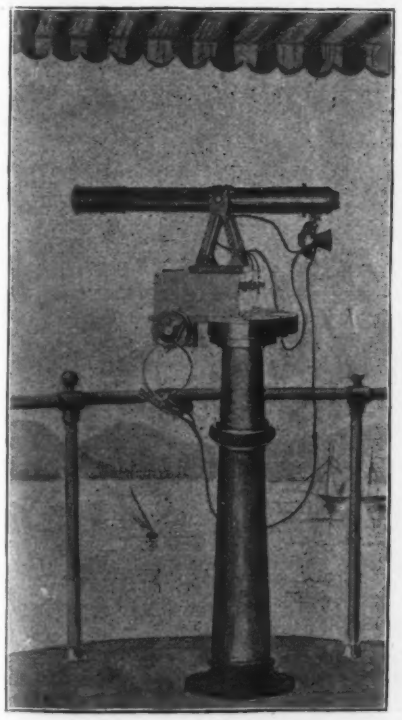


FIG. 11.—FISKE RANGE FINDER.

Passing from the bridge to the pilot house

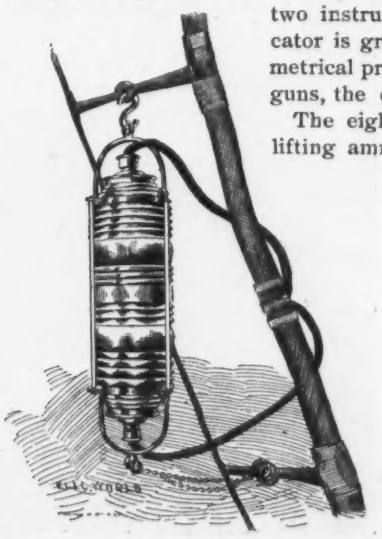


FIG. 12.—ARDOIS LAMP.

An addition to the instruments already described is one for automatically blowing the whistle at stated intervals. It is simply a clock arrangement operating an electric contact, completing a circuit which in turn operates by means of a magnet a lever attached to the steam whistle. A telephone also runs from the pilot house to the "central station," where it is connected to the desired circuit.

The Fiske "Range Finder," one instrument of which is situated just above the bridge and the other on the bridge deck aft, 42¾ yards apart, consists of two pedestals, on each of which is mounted a telescope with cross hairs, also an indicating instrument placed in the conning tower, consisting of a Deprez d'Arsonval type galvanometer, manufactured by the Weston Instrument Company. The

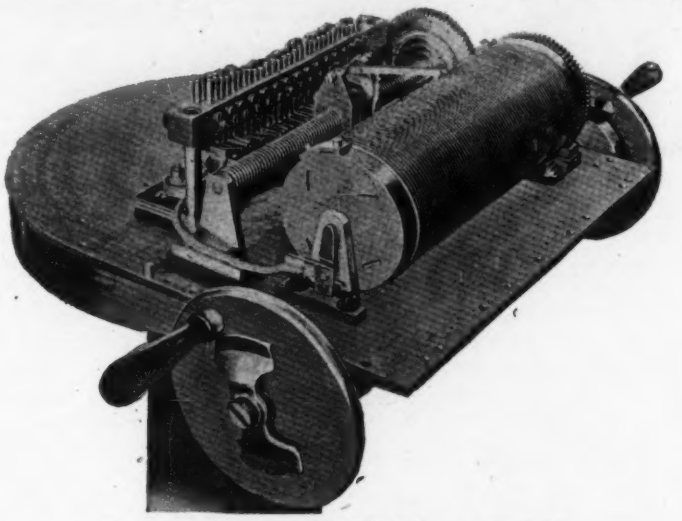


FIG. 13.—INTERIOR VIEW OF RANGE FINDER.

graduations on the galvanometer are in yards. The observers at the two telescopes are connected by telephone with each other, and with the observer at the indicating instrument. The operation of these instruments is also based on the Wheatstone bridge principle, but instead of employing resistances in the form of arcs of circles, the resistance wire is wound upon cylinders which, by means of proper gear, revolve simultaneously with the lateral movement of the telescopes. This method allows of correcting for inequalities in the resistance wires which is done by moving the contact point perpendicular to the axis of the cylinder by means of a surface formed by elevating or lowering a series of pins as shown in Fig. 13, the height of which is determined when testing the instrument. When the two telescopes are parallel, and the circuits are in correct adjustment, the reading instrument, located in the conning tower, points at infinity. An adjustable resistance is in series with the voltmeter so that if the E. M. F. of the storage battery supplying the circuit changes or the resistance of the indicator changes, due to temperature effects, the same may be corrected .

Upon pointing the two telescopes upon the same object the indicator needle is deflected and will indicate the distance in yards, and the object is from a position on the base line half way between the two instruments. Space will not permit of showing how the indicator is graduated, it being done, however, by a simple trigonometrical process. Similar range indicators are located at the various guns, the entire firing of which is directed from the conning tower.

The eight-inch gun turrets have electrically operated hoists for lifting ammunition from the lower deck to the gun breech. These

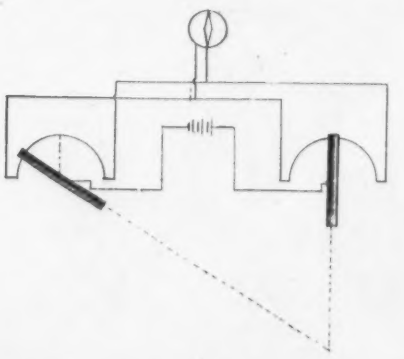


FIG. 14.—DIAGRAM OF RANGE FINDER CONNECTORS.

equipments were furnished by the General Electric Company. In the 13-inch gun turrets two Lundell fan motors are used to blow the smoke out.

The dynamo and engine room contains three navy standard marine generating sets composed of three 24-kw G. E. compound-wound dynamos, connected direct to three G. E. navy standard

marine vertical double-cylinder engines. The units run at 400 revolutions per minute, and deliver each 300 amperes at 80 volts.

The switchboard is designed for 22 circuits, 20 now being in use. There are two switches for the lighting circuits, four for searchlights and six for ammunition hoist motors. The switches are arranged so that each can be thrown on one of the three dynamos; the board is also provided with three parallel switches for throwing dynamos in parallel when necessary.

There are two instrument boards, one on each side of the switchboard, the one on the left having two Weston station voltmeters, ground detector lamp and switches; one voltmeter is used for the lighting and motor circuits, the other for the searchlights. The instrument board to the right has mounted upon its face three Weston astatic ammeters, one for each machine.

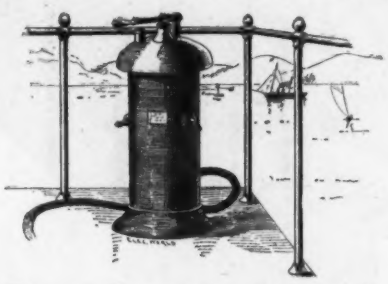


Fig. 15.—Searchlight Controller.

The ship is supplied with the necessary electrical testing instruments, consisting of one 20,000-ohm magneto, one Eversbed testing set, comprising one portable hand-generator and ohmmeter. There is also supplied for testing one hand tachometer, one hand-speed indicator and three Tabor engine indicators.

There are 615 incandescent lights installed on the ship with the necessary water-tight feed and junction boxes, switches and receptacles. Two running lights or lanterns are attached to the mast, the upper one being the mast headlight and the lower is used with the upper when towing.

The side lights are composed of two stationary lanterns, one on the port and one on the starboard side of vessel. These lights are burning only when the ship is in motion.

When the ship is at anchor there is a lantern hung on a halyard half-way from top of mast to bow, also a lantern at the stern, and a lantern swung out by means of a boom over each propeller.

The lights are distributed throughout the ship by means of two sets of circuits, one being the lighting circuit, the other the battle circuit, which is only used when the ship is in action.

The fixtures are all of the navy standard pattern manufactured by Page Bros., Boston. They are all water-tight and of a special type and are composed of battle lanterns, hand portables, deck lanterns, desk lights, bulkhead fixtures, cargo reflectors and electroliers. In the officers' quarters the fixtures are all silver-plated.

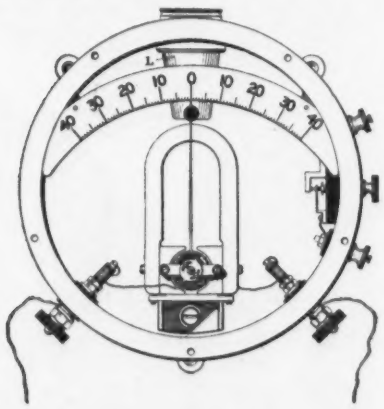


Fig. 16.—Type of Galvanometer.

The wire used for this work is of the navy standard and was furnished by the Safety Insulated Wire & Cable Company, New York. Taking all the different sizes there is about seven miles of wire and about three and one half miles of wood moulding for the same.

The wires are all in moulding and are very thoroughly insulated, being carried through rubber tubing at each beam, the beams being four feet apart and through water-tight stuffing tubes at each water-tight bulkhead or where the wires pass through decks.

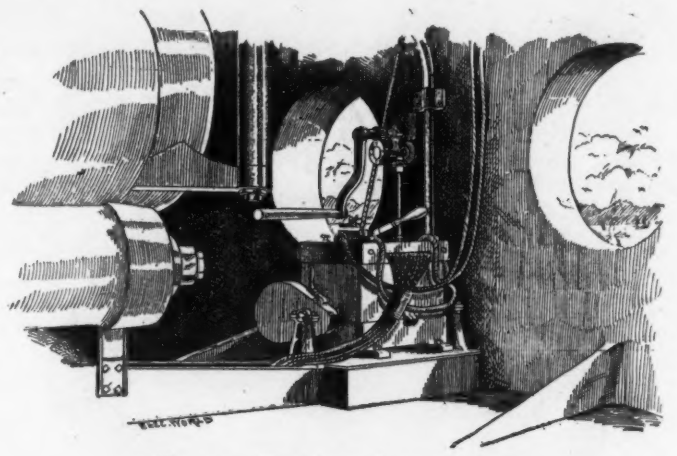


Fig. 17.—Electric Annunciator.

There is a complete set of fire and water alarms throughout the ship. The electric thermostats consist of an iron thimble containing mercury and provided with a non-combustible fibre cork. Through the latter is a small screw passing down through a glass tube. By turning the screw the thermostat may be set for any desired temperature. Upon heat being applied to the thimble the mercury rises and makes contact, which indicates on an annunciator placed aft. The water alarm consists simply of a float which rises and completes an electrical circuit when the water in that particular department attains a certain height.

A telephone system consisting of 24 Claymond telephones and a "central station" is one of the features. Speaking tubes with buttons and annunciators are run from all principal points to the central station and conning tower. The central station is located in the forward part of the protective deck inside of the armor belt. Lieut. Fiske's apparatus was made by the Western Electric Company and with the exception of the range finder was installed, together with the annunciator, fire alarm, revolution counters, etc., by Messrs. Charles Cory & Son, New York.

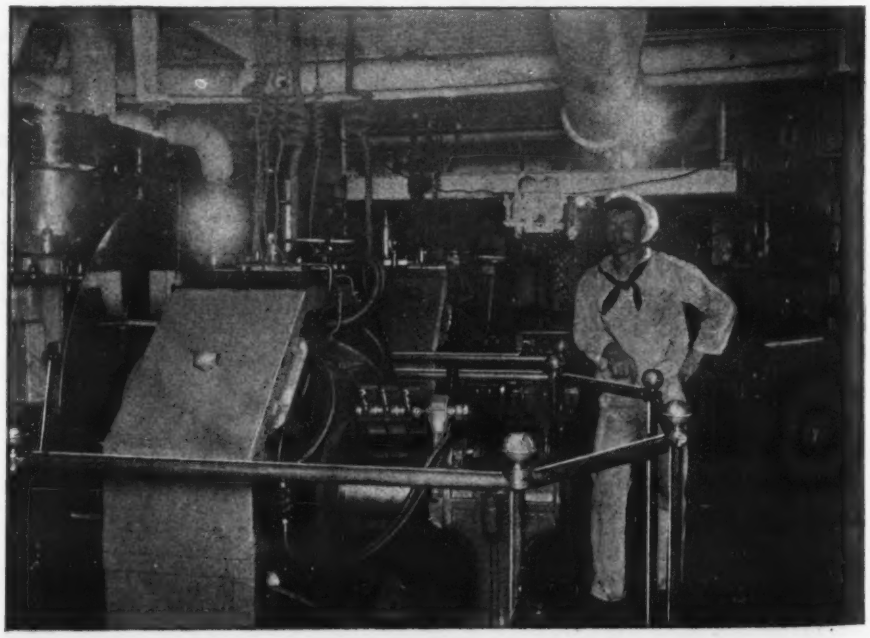


Fig. 18.—Dynamo Room.

The apparatus employed on the *Indiana*, although at the time it was installed it was of the latest design, will be changed in several material particulars on Government vessels now under construction. From the foregoing description it will be seen that electricity now plays a most important role in modern naval engineering.

The Use of 220-Volt Lamps.

During the past two years the question of supplying electrical energy on a two-wire 220-volt or a three-wire 444-volt direct-current system, using 220-volt lamps, has been subjected not merely to a theoretical discussion of the possible advantages which might thus be derived, but such systems, especially the two-wire, have been in successful operation sufficiently long to demonstrate the commercial practicability which the 220-volt lamp has attained. Nearly 20 plants are now in operation in the United States, and judging from the attention which the 220-volt lamps are receiving, their adoption will rapidly increase and at the same time the manufacturers will be better able to supply a more efficient product. The types of American lamps used, shown in one of the accompanying illustrations, have anchored single filaments and with the exception of the longer filaments differ little in appearance from the ordinary 110-volt types. This construction is in marked contrast to most of the foreign makes, which latter indicate an attempt to combine two 110-volt filaments in one lamp rather than surmount the difficulties attendant in the production of a single-filament lamp.

The following abstract of a paper read before the English Municipal Electrical Association, on "Electricity Supply at 220-Volts," by Mr. A. S. Barnard, sets forth some of the advantages which are to be obtained in the use of high-voltage lamps. In this paper the author states that the question of the most suitable pressure at which to supply current from a central station depends, to a very large extent, on the area of the district to be supplied and the position of the central station. As, however, nearly all systems of supply include networks of distributing mains, which are maintained at about the same pressure as required by the lamps on the consumers' premises, and which networks are fed from sub-stations or generating stations, as the case may be, he proposes to deal chiefly with the advantages and disadvantages of the use of 220-volts on the distributing mains, without going very much into the question of whether it is better to have one or more low-tension generating stations to supply current to the network, or a high-tension generating station with a number of sub-stations.

Mr. Barnard states that whatever doubt may exist as to the benefits to the consumer of the higher voltage, there can be no question as to the immense gain to central stations by its adoption. In the majority of cases the change that will be likely to be made will be the doubling of the pressure throughout, making 400 to 440, or even 460, volts across the outer wires, with 200 to 230 volts at the consumers' terminals.

Briefly the advantages of the change will be as follows:

1. Existing mains can supply twice as many customers, at the same time reducing the percentage of loss in the cables by one half.

2. Variations and fluctuations due to the switching on or off of motors or large groups of lamps, or carelessness in switching dynamos in or out at the station, are all reduced by at least one half.

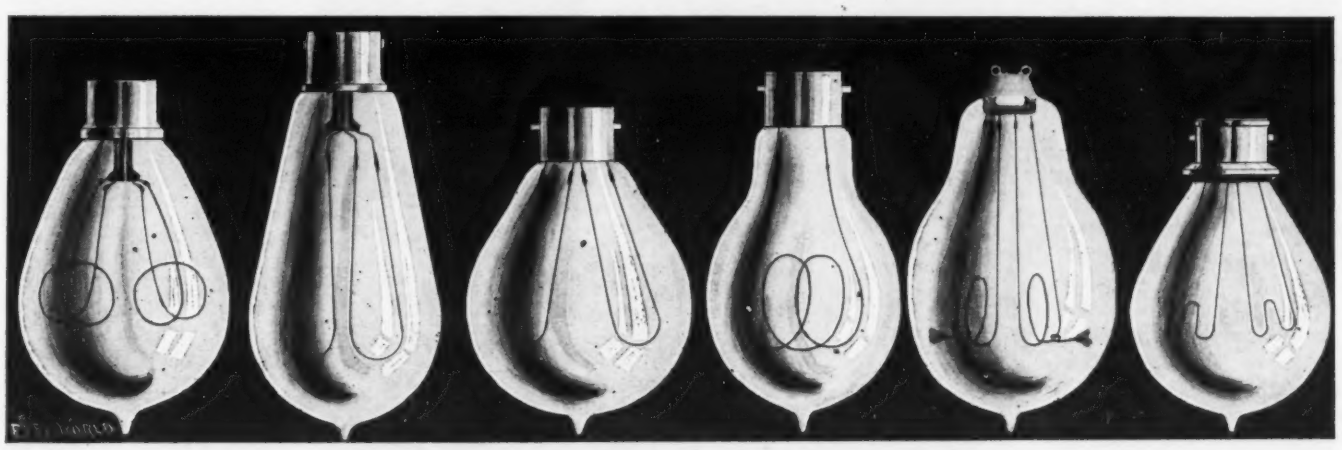
3. New customers can be supplied at a much greater distance from the station.

On the first point little need be said. In connection with most stations that have been in operation two or three years it has been found that some at least of the distributing mains were overcrowded and needed either to be increased themselves or to be supplied by larger feeders. As electric light becomes more and more recognized as a necessity and not a luxury, this increasing of mains will be found to be a very heavy item of expenditure indeed; and any means by which twice the number of consumers can be supplied, with the further advantage of reducing the percentage of loss, or four times the number of consumers with the same percentage of loss, will be gladly welcomed by the engineers responsible for furnishing a supply at an unvarying pressure to any number of persons who may apply for it.

It had been thought that the same end would be attained by the use of 110-volt lamps, the manufacture of which was to be so improved that they should give the same light with little over half the current they formerly took. At present the best 220-volt lamps in the market take about 3½ watts per candle-power, and the most efficient 110-volt lamps about 2½ watts. That is to say, the 220-volt lamps will consume about 40 per cent. more current than high-efficiency 110-volt lamps. Moreover, if we *must* have 2½-watt per candle-power lamps, at any rate with 16 candle-power and all larger sizes, we shall in course of time get them, even at 220 volts. Even now it is only with the 8 and 16-cp lamps that there is any difficulty; and when they do come they will have a far better chance at 220 volts of obtaining the steady pressure, free from fluctuation, necessary for their economical use, than ever they have had at 110.

And now as to the second point—the reduced variation of pressure. Suppose a consumer having a motor or any other appliance taking 40 amperes at 100 volts is situated at the far end of a rather long main. When he switches the motor on or off he will very probably cause a "jump" in the neighboring lights representing perhaps 4 volts, or 4 per cent. of the standard pressure. If instead he were supplied at 200 volts, not only would his current be reduced to 20 amperes and the consequent variation in the voltage to two volts; but, as two volts is only *one per cent.* of 200 volts, the effect on the lamps would be reduced to one quarter, or, in nine cases out of ten, what was previously an annoying little flicker would become quite unnoticeable. Again, stations where a number of 100-volt machines are run in parallel are dependent upon the switchboard attendant, and perhaps some automatic device, to switch each machine in and out at exactly the right voltage. Now, every attendant has his own "coefficient of personal error"—amounting to perhaps three volts, and even the best automatic switches have a similar margin to a greater or less extent. On a 100 to 110 volt system, a machine being switched in at 103 or 113 volts can be noticed at the lamps, and if, as sometimes happens, it is 105 or 115 volts, the effect is a decided jump in the light. On a 200 to 220 volt system the same errors will probably be made, but their effect will be reduced to one half, as it is the *percentage* of variation in the pressure at a lamp that is noticed. Altogether, the author believes, that doubling the pressure at the lamps will make a marked and decided improvement in the steadiness, and will reduce the variation from the standard pressure at any point in the mains to a very great extent.

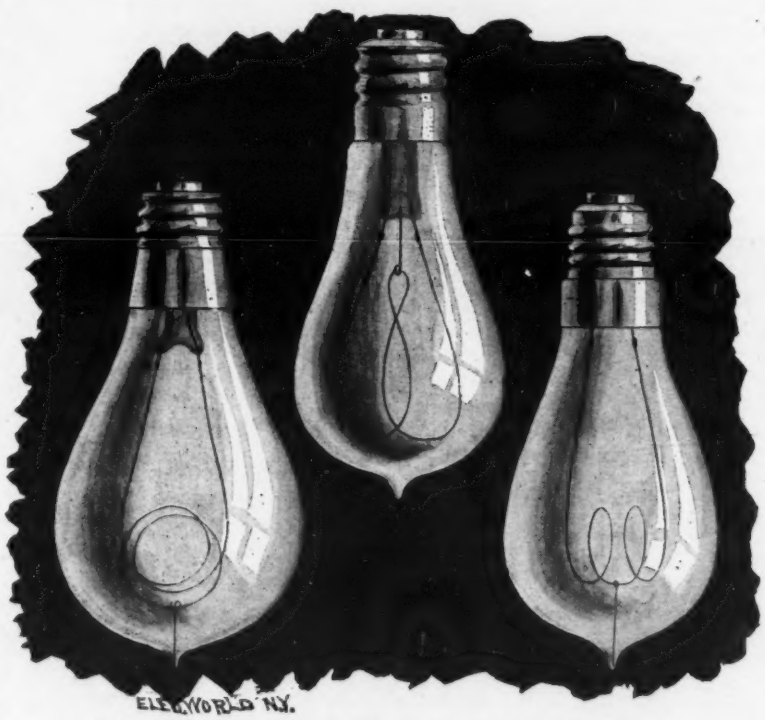
With regard to the third point mentioned, the advantages to be derived from changing over to 220 volts are so patent as hardly to need enlarging on. A station distributing at 110 volts on a three-wire system can supply an area of about one square mile, or say to a distance of about half a mile on all sides. To supply beyond this distance and maintain a reasonably constant pressure necessitates the use of such heavy copper mains and feeders as become



FOREIGN TYPES OF HIGH-VOLTAGE LAMPS—HALF SIZE

Cruto. Stearn. Sunbeam. Edison & Swan New Type. Stearn.

almost prohibitory, and the point is very soon reached at which it pays better to adopt a high-tension system with transformers. Now there are a number of low-tension stations throughout the country which have been established in the heart of the busiest quarters of the town, and which are supplying at 110 volts profitably and well. After a time, though, demands arise for current in the residential and outlying districts, and these demands have to be met. How shall it be done? By establishing a number of little low-tension stations all around the outskirts of the town, or by putting down a high-tension station to work independently of the existing station? He believes that neither of these plans can compare in efficiency and low cost with that of doubling the pressure at the existing station, and so increasing the area over which its operations can extend. To what distance it is possible to supply economically at 220 volts can hardly be said to be settled as yet. Mr. Addenbrooke claimed that a 220-volt three-wire system could cover an area of 25 square miles from one station. No doubt it could if the mains were heavy enough and the limits of variation in the pressure not too stringent. In changes of this sort two points should be kept in mind—first, improvement in the lighting service; second, economy in the capital outlay and working expenses. As regards improvement in regulation—if the present condition of things in most towns having a supply over an area of about one square mile, from one station, be the best that is obtainable at 110 volts, it would seem that too much loss has been allowed in the distributing mains, and the error should not be repeated when the area is being extended. When doubling the pressure it will be quite enough to expect to be able to supply to double the distance, with rather smaller mains—calculated to allow the same actual loss to the farthest lamp, as at present allowed to the farthest lamp in the small area—the percentage of variation in the voltage being then reduced to one half of what it is at present. Mr. Barnard stated that he would not care therefore to recommend attempting to supply much more than four square miles from one station or sub-station; and this could be done in the case of many existing stations by doubling the pressure, using mains which cost little over half as much as the mains laid in the business parts of the town, and yet reducing the loss and variation of pressure at the lamps to half the percentage obtaining at present. It must be borne in mind, too, that in cases of this kind the new area to be supplied will probably not be nearly equal to the present area in the number of lamps connected per yard of mains laid; and whatever basis is taken in determining the size of distributing mains to be laid in the business parts of the town, it should be quite safe to take two thirds, or even half of that figure as the basis for mains laid in streets of villas, private houses, etc.



American Types of 220-Volt 16-cp Lamps—Half Size.
Bryan-Marsh. Edison. Columbia.

The above remarks have for the most part referred to existing 110-volt systems, and the advantages they would derive from changing over to 220 volts. In the case of new works, not yet laid down, the advantages are much greater. It is well known what a heavy strain on the first few years' working is the payment of interest on, and redemption of, capital; and if by its means the expenditure in mains can be reduced by one half, and at the same time a steadier and less variable light given to the farthest customers—who is there who would not favor the adoption of the 220-volt lamp?

The next point is, How will the higher pressure affect the wiring and fittings on consumers' premises? As far as present experience goes, there is nothing to fear on the score of increased fire risk. Installations designed for 100 or 110 volts pressure when changed over to 220 volts run very little, if any, extra risk. The current in the wires is reduced to about one half of what it was, and this quite balances the objection to the pressure being doubled. As a rule, it is not the insulation of the wires that is at fault in an old installation so much as the badly made joints and overloaded wires. A badly soldered joint is far less likely to cause trouble under the new conditions, as the heating would be less and the loss of voltage at the joint would be proportionately to the voltage of the lamps less also. Many of the flimsy little switches, cut-outs, and ceiling rosettes, too, where the insulation is fairly good, are really *safer* with 220 volts and the reduced current than they were with 110 volts. Certain little American switches which are largely in use at Hull, and which get perceptibly warm with a 32-cp 110-volt lamp, will keep quite cool, and work with less sparking, with a 220-volt lamp of the same candle-power. In most of these little auxiliary appliances the E. M. F. has been amply provided for—but the carrying capacity of the screws, terminals, contact-plates, etc., is sadly overestimated.

In the matter of fuses, given a sufficient length of break, a fuse appears to act more suddenly and certainly at 220 volts than at 110. Single-pole fuses are certainly to be preferred to double-pole, for these latter are seldom constructed with the poles sufficiently separated to be safe from arcing when the fuses melt; also, the moisture which often condenses on a porcelain base is more likely to cause serious leakage, and perhaps arcing, with 220 volts than with 110. In wiring new premises for any considerable number of lamps at the higher voltage a slight saving may be made in the cost of wires. Even allowing a rather better class of insulation, yet by reducing the main cables to about half the size they would otherwise be, some reduction is made in the expense. This will not apply in the case of small branch wires, and the wiring of shops, etc., for two or three lights, for in these cases it is not the current density so much as the mechanical strength of the wire that determines its size. Mr. Barnard considered that with attention to the details of fittings, such as fuses, switches and ceiling rosettes, wiring at 220 volts will be just as cheap and rather safer than at half that pressure.

With regard to the use of arc lamps some great objections can be urged against the use of 220 volts. The consumer *will* ask to be able to switch off separate lamps and to use one or two lamps without paying for the current of four. Until some means can be devised for reducing the pressure to, say, 50 volts without wasting energy in resistances, this will remain a difficulty, though perhaps something may be done by arranging a number of small arcs to burn in series in one globe. Still, this would be a troublesome and expensive arrangement and the effect would not be the same as with one large arc. Of course, in street lighting from the low-pressure mains the higher pressure would be a great advantage as it would enable as many as eight or nine lamps to be run in series across the outer wires and to be controlled by one switch, thereby reducing the labor of switching the lamps on and off. With electric motors there need not be any trouble as these can be wound to work at 220 volts just as well as at 110, and certainly the reduced current taken by large motors will reduce the cost of the starting resistances, etc., and will also lessen the effect on the lamps in the neighborhood when the motors are started or stopped.

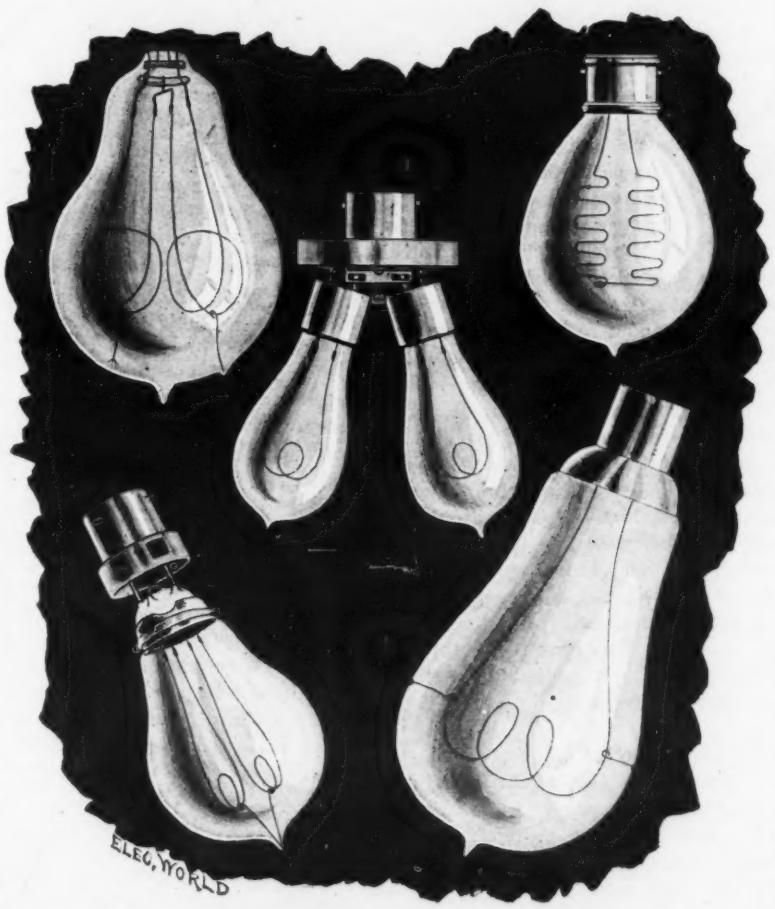
As to the incandescent lamps that are as yet on the market for use at this pressure. In the first place, where lamps are always used in groups of two or four, the ordinary lamps for 110 volts can be used coupled in series. Some makers have even brought out a little fitting for adapting the ordinary lamp-holder, the idea being that, where a 16-cp lamp was in use, two 8-cp lamps should be fitted, and so on. This is very neat, and gets over many of the objections to 220-volt lamps, but it is hardly adapted for universal use, as the

two lamps will not go into many of the glass shades in use, and many people will consider that their appearance is not nearly so æsthetic as that of the single bulb. Other makers have put the two filaments into one bulb or just outside the neck in the plaster cap. Several firms have, however, boldly grappled with the question, and have succeeded in making single-filament lamps having bulbs little or no larger than those commonly in use, and these seem to indicate the lamp that will shortly become commonly adopted. As might naturally be expected, the lamps with single filaments have hardly reached the stage of durability and efficiency that the double-filament lamps have attained. For all that, most excellent results have been obtained from some individual lamps of this type, and equally poor results with samples of double filament lamps. On this question Mr. Gibbings writes as follows: "The 230-volt lamps are very much appreciated by our customers; in fact, we are continually being pressed by those we have not changed over to do so, and find that the life of these lamps comes out, if anything, better than the ordinary 115-volt lamps." Such favorable and positive testimony as this is rather surprising, but the secret is to be found in the steadier and more even pressure supplied rather than in the better quality of the lamps. In either case it is most satisfactory and encouraging, and should help to convince any who doubt the possibility of a commercially good 220-volt lamp being made that, at any rate, it is quite possible to equal the 110-volt lamp.

In the lamps under Mr. Barnard's observation the average life is quite equal to that of the best makes of 110-volt lamps. With the exception of one maker's samples, the candle-power has been maintained longer, and there has been less blackening of the glass. Several lamps fail through short-circuits occurring in the cap, but this fault also is absent from the lamps of several makers. Other lamps have failed through the long filament touching the glass while hot, and so cracking it and admitting air, and especially has this been the case when these lamps have been run in any position other than vertical.

All the makers are now working toward the elimination of these defects, and several have already successfully got over the difficulties, as may be judged from the accompanying illustrations.

The belief was expressed that the 220-volt lamp will soon be recognized as the most useful advance that has been made in electric lighting in the past year or two. It is on the market now, is being fairly tested and found satisfactory in several towns, and it has "come to stay."



FOREIGN TYPES OF HIGH VOLTAGE LAMPS—HALF SIZE.

Edison & Swan Old Type. Gossens, Pope & Co. | Gabriel & Agenault. | Stearn. Fuller & Co.

Water as a Non-Inductive Resistance.

Prof. Fleming has shown experimentally with a 2000-volt alternator, loaded with a water resistance, that the latter is quite non-inductive and that the readings of the amperes may be taken as a measurement of the voltage and the product of the volts and amperes will represent correctly the power consumed.

Transformers in England.

According to Dr. Fleming, the weight of iron cores in all the transformers used in the United Kingdom is not less than 400 tons, requiring at least 400 kilowatts to maintain magnetization; this corresponds to about 1,600,000 kw-hours per annum, or to at least 16,000,000 pounds of coal, equal to about 8000 tons and amounting to about $30,000.

Electric and Magnetic Research at Low Temperatures.

BY J. A. FLEMING.

(*Continued from page 168.*)

The general result of our investigations at low temperatures is to show that while in some cases the thermo-electric lines are approximately straight lines for temperatures down to the lowest reached, they are not all by any means straight lines. In some cases, such as iron and bismuth, we find sudden changes of direction of the thermo-electric lines similar to those found by Prof. Tait at higher temperatures, and this indicates a change in sign in the Thomson effect at that point. Moreover, in many cases there is a decided tendency of the lines of many metals to bend round in a manner which indicates that their thermo-electric power probably would become zero at the absolute zero of temperature.

The temperature at which the thermo-electric line of any metal crosses the line of lead gives us the neutral temperature of that metal with respect to lead, and at that temperature the metal is thermo-electrically identical with lead. If one junction of a couple is at a temperature as far above the neutral temperature of the metals as the other is below it, the couple will give no E. M. F. This provides us with an experimental method of determining the position of certain neutral points. Thus, for instance, if one junction of a platinum-zinc couple is placed in liquid air and the other is raised to about 30 degrees, we get no E. M. F. from that couple. This indicates that the neutral temperature of platinum and zinc is about — 85 degrees, and this is shown to be the case from the chart. Two general conclusions are arrived at from a study of the thermo-electric lines as laid down in our chart. The first of these is that the thermo-electric lines of many metals are by no means straight lines over extreme ranges of temperature. Hence the thermo-electric power is not simply a linear function of the absolute temperature. The second important fact is that in the thermo-electric lines of certain metals at low temperatures there are sudden changes of direction which indicate a change in the sign of the Thomson effect in that metal, and probably therefore some important molecular change at the corresponding temperature.

In the case of the 29 per cent. nickel steel alloy there is an interesting thermo-electric phenomenon. If a loop of wire of this material is partly dipped in liquid air the portion cooled becomes thermo-electrically different from the remainder, and gives a strong thermo-current if connected to a galvanometer and warmed at one point where the changed and unchanged portions meet.

Leaving the further elaboration of these points, we must next notice some of the facts with respect to the magnetization of iron at low temperatures. Prof. Dewar mentioned, in a discourse on "The Scientific Uses of Liquid Air," some results obtained on cooling small steel magnets. These effects we have since again explored at greater length. Let me show you, in the first place, the effect of cooling a small steel permanent magnet to the temperature of liquid air. We will first take a magnet made of knitting needle or ordinary carbon steel and examine the effect of low temperature upon it. Placing the magnets behind the small suspended magnetic needle of a magnetometer, we obtain a deflection of the magnetometer needle, which is a measure of the magnetization of the magnet causing the deflection. On bringing up a small vessel of liquid air,

and immersing in it the magnet under test, there is at once a sudden decrease in the deflection of the magnetometer needle. This indicates that a notable percentage of the magnetization of the magnet has been removed. On taking away the air bath, and allowing the magnet to heat up again, we find that there is a still further decrease in magnetization. On cooling it again with liquid air the magnetization increases, and from and after that time the effect of the cooling is always to increase the moment of the magnet, and the effect of heating it up again always to decrease the moment of the magnet. Hence we see that the effect of the first immersion in liquid air was to give a shock to the magnet, which deprives it permanently of a considerable percentage of its magnetism, but when once it has survived the treatment, then cooling it strengthens the magnet, and warming it weakens it.

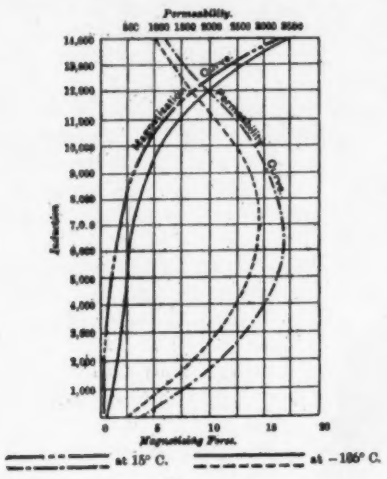


Fig. 9.

This is not by any means always the case. If we take a magnet made of the 19 per cent. nickel steel, the peculiar characters of which were explained a few moments ago, we shall find a very different state of affairs. We see here the first effect is, as before, to remove a very considerable percentage of the initial magnetization, but after that stage is passed then cooling the nickel steel magnet always weakens it still more, and warming it up again strengthens it. The subsequent effect of cooling is, therefore, in the opposite direction in the carbon steel and in this nickel steel.

We have in this way examined the behavior of magnets made of a very large number of steels—chromium steels, aluminum steels, tungsten steels, silicon steels and nickel steels in various states of temper, hard and soft. We find that in some cases there is no initial decrease of magnetism at all, and that the steady state begins at once. Broadly, however, the results amount to this. A steel magnet when plunged into liquid air generally loses some fraction of its magnetization, but that after a few such immersions it arrives at a fixed condition, in which the effect of cooling it is in most cases to produce an increase of magnetic moment, but in a few exceptional cases to produce a decrease of magnetic moment. In the technical use of magnets for instrumental purposes they have to go through a process called *ageing* to get rid of the sub-permanent magnetism; one of the ways of ageing a magnet is to plunge it several times into liquid air.

We have given a large amount of attention to a study of the change taking place in the magnetic qualities of soft or annealed, and also hard iron when cooled to very low temperatures.

Assisted by Mr. J. E. Petavel, who has given us most valuable help in these very tedious magnetic observations, as well as in the subsequent reductions of them, we have made a large number of observations in the permeability of a carefully annealed iron ring made of very pure Swedish iron of the highest quality.* The result is to show, as seen from the curve, Fig. 9, that cooling the iron to — 200 degrees slightly diminishes the permeability. In other words, it requires a greater magnetic force to produce a given amount of magnetization when the iron is at — 200 degrees, than when it is at the ordinary temperature. When, however, we began to study the behavior of hardened iron in this respect we find ourselves in the presence of very curious effects. If pure iron, which has been carefully annealed, is twisted, knocked, bent, stretched, or compressed, it passes into a state known as hard iron, and hard iron has very different magnetic qualities from soft iron. A very extended series of experiments with rings of hard iron have shown that hard iron, at least in certain cases, has its permeability greatly increased by cooling (Fig. 10), and this change takes place with great suddenness. This can be shown by a simple experiment. If we take a hard-iron ring which has two coils of wire wound round it, and connect one of these circuits to a battery, we shall send a current through the primary coil and magnetize the iron ring. If the other or secondary circuit is connected to a galvanometer, then at the instant of starting the primary current there is a transitory induced current produced in the secondary circuit. As long as the induction in the iron remains constant, no electric change will take place in this secondary circuit. If, however, we plunge the iron ring into liquid air, while still keeping the primary current constant, we find again a secondary current produced at the moment of cooling the iron. This indicates a sudden increase of permeability at the instant of cooling. If we bring the ring out of the liquid air, we find it retains some of the increased permeability acquired in cooling, but loses a portion of it more slowly if it is heated up again to ordinary temperatures by plunging it into a bath of alcohol. Owing to these changes we found it impossible to repeat again exactly any required magnetization curve in the case of the hard iron. The sudden cooling alters the magnetic qualities of the unannealed iron to such an extent that it is not possible to get it twice in exactly the same state. By subjecting a hard iron ring to frequent reversals of the same magnetizing force while it is heated up slowly from the temperature of liquid air up to ordinary temperatures we have been able to trace the gradual decrease of the permeability at any constant force throughout this range of temperature.

We have found, on the other hand, that unhardened steel piano-forte wire behaves like soft annealed iron.

We have then examined the hysteresis of iron at low temperatures. The method we adopted was the laborious but exact one of delineating a complete magnetization curve of the iron by means of observations taken with the ballistic galvanometer for various maximum values of the magnetizing force. In this way we were able finally to arrive at a curve which represented by its ordinates the value of the hysteresis loss in the iron in ergs per cubic centimetres per cycle, and the abscissæ the maximum value of the corresponding magnetic induction. When curves had been drawn out from all the many hundreds of observations for the same soft iron ring at ordinary temperatures and at the temperature of liquid air, we found little or no sensible difference between them. The result is, then, that there is no appreciable change in the magnetic hysteresis loss of very carefully annealed soft Swedish iron when cooled to these low temperatures. With regard to the hard iron, although the permeability is increased, it is most difficult to say yet whether the hysteresis is increased or not, as every fresh reduction in temperature of the iron alters its physical state and makes it almost impossible to obtain similar repeated measurements.

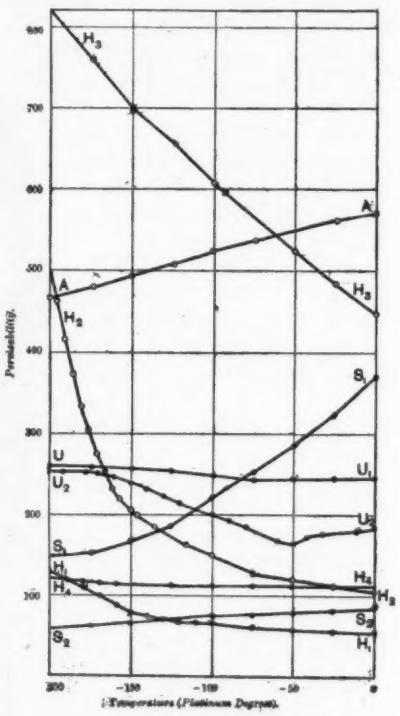


Fig. 10.

A, soft annealed transformer iron, ½ scale, magnetizing force, 1.77. H_1, hardened iron, magnetizing force, 2.60. H_2, hardened iron, magnetizing force, 4.92. H_3, hardened iron, magnetizing force, 11.16. H_4, hardened iron, magnetizing force, 12.77. S_1, steel, magnetizing force, 20.30. S_2, pianoforte steel, magnetizing force, 7.50. U_1, unannealed iron, ½ scale, magnetizing force, 9.79. U_2, unannealed transformer iron, ½ scale, magnetizing force, 1.78.

It is natural to inquire how far accepted theories of magnetic action are able to reconcile the above-mentioned results. Some of them undoubtedly are in accord with deductions from received hypotheses. It is generally considered that the facts connected with the magnetization of iron indicate that each molecule, or perhaps small groups of molecules, of the iron are complete micromagnets, and that in the unmagnetized condition of the iron these molecular magnets arrange themselves in groups or in closed circuits so that for each little group the external magnetic action or magnetic moment is approximately zero. Magnetization consists in arranging the members of some or all of these groups, so as to co-lineate the

*It is only right to add that in other portions of this work we have been much indebted for persevering assistance to Messrs. J. and D. Morris, and in lesser degree to Messrs. Jakeman and Tilney for help in observations requiring several simultaneous observers.

direction of more or less of the molecular magnets and produce an external resultant magnetic moment. Let us then consider one such little group by the aid of a model made of small magnets, such as Ewing has suggested and used. Suppose the members of this group to be at a certain distance from each other and we apply a given magnetizing force, which is just sufficient to open out the group and co-lineate the magnetic axes of the several members of it. Next suppose we cool the iron; this would result in bringing the members of the group into closer contiguity. The result of this will be an increase of the interpolar magnetic forces of the different members of the group, and it would require a greater magnetic force to effect the same amount of co-lineation of the molecular magnets. This, however, corresponds with what we find to be the case on cooling soft iron to very low temperatures. Prof. Dewar's experiments have shown that the tensile strength of iron and steel is increased to about double on cooling to — 182 degrees C., and it is quite reasonable to suppose that this result is in part at least due to an approximation of the molecules.

As regards the behavior of magnets when cooled it is highly likely that when the groups of molecular magnets have been opened out more or less, that some of these are in a condition of instability in which bringing the members of the group nearer together will have the effect of making them close up again into magnetic circuits of no external action. Hence, if this is the case, the first effect of the sudden cooling will be to reduce the magnetic moment. These half-hearted groups of molecular magnets constitute the sub-permanent magnetism which it is our desire to get rid of in ageing a magnet. Then, as regards the effect of temperature changes on the magnet when the stable condition of affairs is reached. In order to explain this, I think we must consider the action of the molecular groups upon each other. The approximation of molecular groups will in general, after the magnet is aged, have the effect of co-lineating more completely the different members of the groups, and hence increase the magnetic moment of the magnet, while the separation of the molecular groups and the reverse magnetic effects will ensue on heating up. The action of the low temperature upon soft iron and upon magnetized steel would be explicable if we may legitimately make the assumption that lowering the temperature approximates the molecular groups and also the members of each group.

The result of this, in the case of existing permanent magnetization, is to close up more or less those groups which are in an unstable condition, but it increases the co-lineation in those groups in which the magnetic moment exceeds a certain value. Hence in the case of the permanent magnet, the first effect of sudden cooling is a compound effect ; it consists in a great reduction of the magnetic moment of certain unstable groups, but in an increase of moment of others. After this initial stage is past the normal effect is an increase of magnetic moment of the groups by bringing them closer together, and a diminution by increase of distance.

There remains then to be explained the anomalous behavior of the nickel steel and hardened iron, but the attempt to throw an inner light upon the results obtained with these substances cannot possibly be successful until we have explored far more thoroughly at low temperatures the changes in mechanical as well as magnetic qualities.

However much one may be tempted to speculate upon the causes of these various changes in the properties of matter at very low temperatures, a much more important duty at the present time is the collection of facts and the completion of accurate quantitative measurements.

The experimental difficulties of this low-temperature research are very great, but both Prof. Dewar and I have been chiefly anxious in this particular work to prosecute preliminary explorations into as many regions of it as possible, these pioneering experiments enabling us to ascertain in what direction further inquiries will be profitable.

Every step forward opens up fresh suggestions for investigation, and, I may add, fresh difficulties. In the light of the results, however, thus ascertained we shall have additional means of testing and judging existing electrical theories, and the facts themselves when built into the fabric of scientific knowledge will serve to broaden those foundations on which we may profitably erect new hypotheses of electric and magnetic phenomena, which, even if they cannot dissipate entirely that mystery which enshrouds even the most familiar facts, will serve as a continual stimulus to thought and work in days and years that are yet to come.

Buffalo Meeting of the Society for the Promotion of Engineering Education.

The meetings for reading of papers and transaction of business will be held at the room of the Engineers' Society of Western New York in the Buffalo Library building at 9.30 a.m. and 7.30 p.m. of Thursday, Aug. 20, and Friday, Aug. 21, and the evening of Saturday, Aug. 22, leaving Thursday and Friday afternoons for visits and excursions to points of interest in and near Buffalo, and all day Saturday for the excursion *via* electric railway to Niagara Falls and Lewiston.

The following programme of papers to be read has been prepared:

Thursday Morning, Aug. 20.—President's address, "Past and Present Tendencies in Engineering Education," Mansfield Merriman.

Report of Committee on "Uniformity of Symbols for Engineering Text-Books," I. O. Baker, chairman.

"Agreement on Definition of Engineering Terms," Thomas Gray.

"Seminar Methods as Applied to Engineering Subjects," F. P. Spalding.

"An Experiment in the Conduct of Field Practice," F. O. Marvin.

Evening Session.—"A Quarter Century of Progress in Engineering Education," Robert Fletcher.

"The Method of Teaching Perspective to Engineering Students," H. S. Jacoby.

"The Study of Modern Languages in Engineering Courses," T. M. Drown.

"A Course of Study in Naval Architecture," C. H. Peabody.

"The Elective System in Engineering Colleges," M. E. Wadsworth.

Friday Morning, Aug. 21.—"The Desirability of Lectures to Undergraduates on the Ethics of Engineering," C. C. Brown.

"Quantity *vs.* Quality in Smaller Colleges," Albert Kingsbury.

"Biology for Civil Engineers," C. C. Whipple.

"The Conservation of Government Energy in Promoting Education and Research," C. W. Hall.

"The Hale Engineering Experiment Station Bill," W. S. Aldrich.

Evening Session.—"Is Not Too Much Time Given to Merely Manual Work in the Shops?" W. H. Schuerman.

"How to Divide Subjects for Original Investigation Among Different Colleges," C. H. Benjamin.

Report of Committee on "Entrance Requirements for Engineering Colleges," F. O. Marvin, chairman.

"Credit for Shop Experience in Entrance Examinations," W. T. Magruder.

"A Course of Study in Municipal and Sanitary Engineering," A. N. Talbot.

Saturday Evening, Aug. 22.—"Engineering Education in Japan," J. A. L. Waddell.

"Modeling as an Aid to Teaching Machine Design," G. W. Bissell.

"A Course of Study in Mechanical Railroad Engineering," H. W. Hibbard.

New Use for Old Horse Cars.

A novel but very sensible use is made of old horse cars in Connecticut. When the trolley system was introduced in the various cities in that State the problem as to what should be done with the old horse cars remained unsolved until some enterprising genius suggested using them for Summer cottages, hunters' camps, lodges, etc. The public readily fell in with the idea, with the result that all of 600 old cars that went into disuse are now being utilized for these novel purposes. It is stated that all along the Long Island coast, from Watch Hill to Larchmont, these cars may be seen perched up on top of some breezy bluff on the sandy shore, or in some quiet, shaded nook affording temporary habitation for families, fishermen, hunters, etc. The demand for old horse cars has greatly increased in consequence of this new use. One woman recently asked the station agent at New London for his lowest prices for passenger cars, also a list of the various styles. A Norwich party has arranged four cars in the form of a hollow square and erected a canvas awning in the square. One of the cars is used as the kitchen and the others as sleeping rooms, dining-room, parlor, etc. One gentleman has five cars on Block Island, which he has placed end to end like a train. The supply of old cars in this one State has thus suddenly become exhausted.

THE ELECTRIC RAILWAY

The Walker Company's Series-Parallel Controller System.

BY WILLIAM BAXTER, JR.

In the Walker series-parallel system the destructive sparking caused by changing from the series to the parallel connection, or from parallel to series, is prevented by so constructing the switch as to render such action impossible ; the protection of a magnetic blow-out is therefore rendered unnecessary. The principle involved in the operation of the switches used in this system is that of breaking the circuit at a number of points so as to reduce the difference of potential at each break to such a small amount that the spark becomes harmless. This principle was fully explained in THE ELECTRICAL WORLD for June 6, 1896, in an article on the "Walker Type E Street Car Controller."

In the arrangement adopted by the Walker Company, the controller cylinder is provided with a number of contacts to break the circuit at four or five points, when commutations are made that would cause serious sparking if there were but a single break. In addition to these multiple breaks a separate circuit-breaking switch is provided which is used when the main circuit is to be opened. This switch breaks the circuit at 28 points, thus reducing the difference of potential at each break to less than 20 volts. With such a low E. M. F. the spark should not be much over one hundredth of an inch in length, and therefore could not be at all destructive.

The use of this special switch might be regarded as adding complication, but it also removes complication, as it renders the blow-out magnet unnecessary; further, it simplifies to a certain extent the main switch, as will be shown further on.

The changes that are made in passing from the series to the parallel connection are shown in the four small diagrams presented herewith. Fig. 1 shows the connection on the first four steps of the controller switch. The first step connects the motors in series with each other and with all the rheostat resistance. The change effected by the second step is to cut out the first section of the rheostat by a short circuit between R and R 1. The third step short-circuits between R and R 2, thus cutting out two thirds of the resistance. The fourth step short-circuits between R and R 3, and cuts out all the resistance. In passing on to the fourth point the connections become as shown in Fig. 2, and a further movement breaks the direct connection between R_3 and the armature of the first motor, and R, and connects R with R_2. When this point is reached, there are two paths for the current, between R_2 and the armature ; one is through the section of the rheostat from R_2 to R_3, and the other through the five contacts *a*. A further movement of the switch breaks the circuit through the points *a* and leaves but one path which is through the last section of the rheostat.

As the handle is moved still further the last motor is short-circuited, as shown in Fig. 3 and then the circuit through it is opened by breaking at the four contacts *b*. The next change after this places the two motors in the parallel connection with the last section of the rheostat in series. This resistance is cut out in passing to the last step and the motors are left in circuit as shown in Fig. 4.

The manner in which the current finds its way through the various parts of the system can be easily understood by reference to the large diagram, which shows the development of the controller cylinders, the circuit-breaking switches, the reversing and the cut-out switches, the rheostat, the motors and the wire connections.

The circuit-breaking switch, which is shown to left of the controllers, consists of a cylinder provided with 32 contacts arranged in two rows parallel with the axis, and diametrically opposite each other. These contacts are shown in the diagram, in the centre, and are connected with each other in pairs, as indicated by the horizontal lines. The two outside rows of contacts represent stationary fingers, which are so disposed that they will press upon the cylinder contacts when the switch handle is moved in the proper direction. The trolley wire is attached to the second contact from the bottom, which is connected with the finger above it and also, through the cylinder, with the one directly opposite. The stationary contacts are joined together in pairs, as shown by the vertical lines, and as will be seen the current can pass to the wire that connects with the top contact of the controller, either by going through the four lower or the 28 upper contacts. When the switch is closed the greater portion of the current will pass by the lower path. When the switch is opened the four lower points break first, and as the resistance of this path is very low there will be no spark worth speaking of, but when the further movement of the switch opens the circuit there will be 28 breaks in series running from the lower to the upper end of the cylinder, and as the E. M. F. of each break is very low there will be practically no spark.

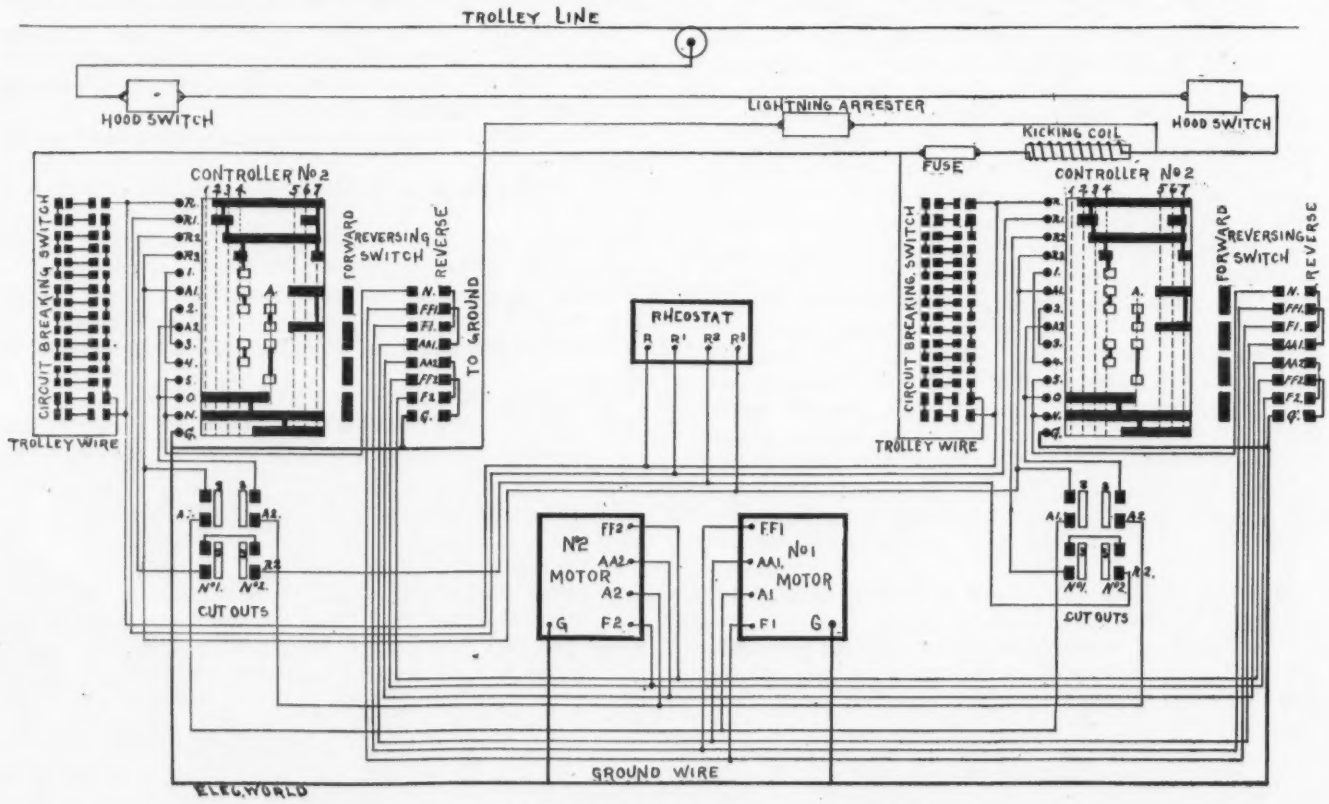


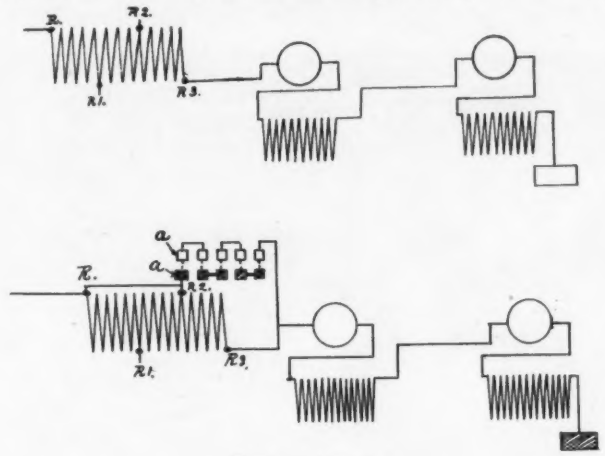
DIAGRAM OF THE WALKER CONTROLLER CONNECTIONS.

As stated above, this switch simplifies somewhat the construction of the controller cylinder ; this is for the following reason : If this switch were removed and the wire R were connected with the

trolley, the circuit through the motors could not be opened by opening the controller switch, as this operation would not break the connection between the trolley and the first terminal of the first motor; and therefore to be able to open the circuit it would be necessary to place another ring on the controller cylinder and a contact finger opposite it for the trolley wire to connect with.

The operation of the controller switch on the various points is as follows:

When the handle is moved to the first point, say of No. 1 switch,



FIGS. 1 AND 2.

the current from the trolley wire passes to the wire R through the circuit-breaking switch, and goes direct to the rheostat, from which it returns by $R3$. As this wire is connected with the top contact of No. 1 cut-out switch, which latter is connected with the second contact $A1$, by the switch-blade S, the current passes to the armature of No. 1 motor by this route and returns by $AA1$ to the corresponding contact of the reversing switch. Here it passes to $F1$, and thus to the field of the first motor, from which it returns to $FF1$, which is in connection with N. From N of the reversing switch the current goes to N of the controller, and here it passes to O, which, as will be seen from the diagram, connects with the top of No. 2 cut-out, and thus by the blade S and $A2$ with the armature of No. 2 motor. The current passes from N to O at the controller, because these two rings are connected with each other. From the armature of No. 2 motor the course is to $AA2$ of the reversing switch, where a connection is made with $FF2$. Thus the current reaches the field of the second motor, from which it returns by way of $F2$ of the reversing switch, and from here goes to ground through the contact G.

On the second point the fingers R and $R1$ pass onto the controller cylinder rings, and short-circuit the first section of the rheostat; owing to the fact that these two rings are connected. On the third point the fingers R and $R2$ pass into cylinder rings, which are also connected, and thus two thirds of the rheostat is short-circuited. On the fourth point fingers $R1$, $R2$ and $R3$ are in contact with cylinder rings, and this short-circuits all the rheostat. As the switch is moved beyond the fourth point $R3$ finger passes off of the cylinder ring, and if it were not for the five cylinder contacts shown in outline on the vertical line 4, the last section of the rheostat would be cut into the circuit again; but through these contacts it is short-circuited. When the fingers pass off of these five contacts the short circuit is broken at five points in series, and thus the spark that would otherwise be produced by the introduction of the resistance into the circuit is avoided.

When the switch is moved far enough to bring the finger G in contact with the corresponding cylinder-ring, the second motor is short-circuited, owing to the fact that the rings N and G are connected; thus a direct path is provided from the end of the first motor to ground. When the switch has moved far enough to break contact between the finger O and its corresponding ring the circuit of the short-circuited motor would be opened if it were not for the four contacts on the line A, but as the finger 5, which is connected with N, is still in contact with the lower of these, the circuit remains closed until the switch moves far enough to break contact with them. When this is done, the motor will be open-circuited, and as the circuit is broken at four points the spark, which on account of the self-induction of the motor would be very destructive if concentrated at one point, is rendered harmless.

When the switch has moved as far as the 5th point, the two motors will be placed in parallel, because the fingers $A1$ and $A2$ will be pressing on rings that are connected with each other; but as $R3$ is not in contact, the last third of the rheostat will be in the circuit. When the switch is moved to the last point this resistance will be cut out.

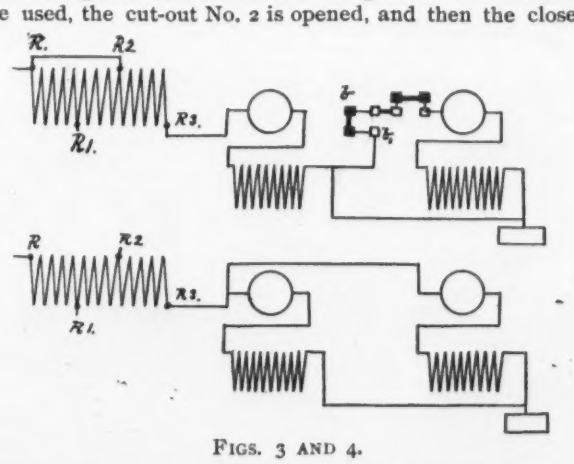
The object of making the cylinder rings $R3$ and O shorter than the outlined contacts below them, on the forward end, is to avoid sparking at these points, and to concentrate it all upon the other contacts.

From the foregoing it will be seen that at the two points where there is a change in the circuit connections that would cause sparking extra contacts are provided, so as to break up the effect and render it harmless. The most destructive sparking, however, is caused by the backward movement of the switch, and, to guard against this, the circuit-breaking switch is used, and it is so connected with the main switch, mechanically, that it will be thrown open by a very small backward movement of the latter; therefore, when the handle is turned back, the first action is to open the circuit. The circuit-breaking switch provides two paths for the current, one through the lower end, which only includes four breaks, and one through the upper end, which has 28 breaks. The object of these two paths is to avoid the necessity of passing the current through all the breaking points while the motors are in service. As the lower path only has four break points, nearly all the current will go that way; but when the switch is opened it is compelled to take the longer route in making final break.

As this switch opens the circuit with the first backward movement of the controller, all sparking when the current is cut off is avoided.

The direction of rotation of the motor is changed by the movement of a separate handle, as is the case with the Westinghouse and General Electric systems. The switch used for this purpose is very simple and requires no special explanation further than to say that for the forward motion the contacts are connected together in pairs successively, while for the reverse they are connected in pairs alternately.

The arrangement for running with a single motor is different from that used by others. It is generally the custom to so arrange the switches that the first points may be used, whether one or both motors are in service. To accomplish this it is necessary to provide means whereby the motion of the handle may be arrested when it reaches the last point of the series connection. This is accomplished by providing a stop that is thrown into action by the opening of either of the cut-out switches. In the Walker system the last points of the switch are used when one motor is cut out, and no device to check the motion of the handle is therefore necessary. If No. 1 motor is to be cut out No. 1 cut-out switch is opened. The path of the current will then be as follows: From the trolley wire it will pass to the rheostat, as was the case when the two motors were in use, but when it returns to $R3$ it will go no further until the switch has been moved to the fifth point, because the circuit remains open at $R3$ until this point is reached. On the fifth point $A1$ and $A2$ are connected, but the current cannot pass by way of $A1$, because the circuit is broken at the cut-out switch; it therefore goes by way of $A2$, and through the second motor to the ground. If the first motor is to be used, the cut-out No. 2 is opened, and then the closed circuit will be through $A1$ and the first motor; and the second one will be cut out.



FIGS. 3 AND 4.

When either one of the motor cut-outs is opened, the connection between $R2$ of the rheostat and the corresponding finger of the controller is broken. This is done so as to not have the first two thirds of the resistance cut out, as would be the case if $R2$ remained closed. With this break the current on the first point, which in this case is the fifth, passes through all the resistance, on the second the first section is short-circuited, and on the next point all the rheostat is cut out.

The Rochester & Irondequoit Park Railway.

This road, although small, is interesting on account of its equipment and because of the fact that it is very profitable in a district where a steam railway proved a total failure. The road was chartered on the 19th of May, 1893, and the following November was leased to the Rochester & Lake Ontario Railway Company, the lease to run for and during the corporate existence of the lessor. The capital stock of the company was then $65,000 and upon this the lessee pays 15 per cent. per annum.

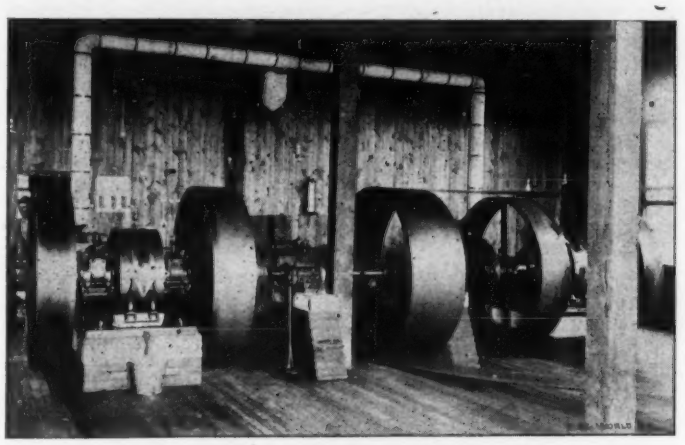
The cars were originally ordinary passenger coaches, running on a very narrow gauge road and drawn by a steam locomotive. With this equipment it was impossible to pay expenses, and an electrical equipment was therefore decided upon. Since May 30, 1896, the single generator owned by the company has been running continuously with the exception of about three hours per day. The road has paid well, and the company is now considering the installation of another generator and adding more cars to the equipment.

The car-barn and power-house are situated near First Avenue and Third Street. The latter is a small wooden structure remodelled for the purpose and has an ordinary sheet-iron stack 60 feet high and 35 inches internal diameter. The fuel used is a mixture of soft coal and screenings, of which about 75 per cent. of the latter are used. This mixture is fed to the boilers in an ordinary spread-fire four inches thick, no attempt being made at coking. The combustion-chamber is 28 inches high from the grate to the boiler shell. The grates are 5 feet 6 inches by 6 feet by 6 feet. About two tons of the mixed coal is burned daily. The coal is delivered in carts and dumped on the boiler-room floor and the ashes are wheeled away in barrows.

The two boilers are of the horizontal multitubular type, are 66 inches in diameter and 16 feet long and contain seventy 3½-inch flues. They are each rated at 100 horse-power and are enclosed in an ordinary brick setting and provided with full fire fronts. The boilers were manufactured by the Stearns Manufacturing Company, Erie, Pa. The boilers are fed by a nose feed pump, with a single system of piping. City feed water is used and no trouble has been experienced with scale. It is a notable fact that cities on or near Lake Ontario are not troubled with boiler scale, while the cities bordering on Lake Erie experienced so much difficulty due to scaling that rather than use the lake water they prefer to draw feed water from the muddy streams and pools containing foreign matter, which is, however, removed by means of a purifier. This they find is much easier to do than to obviate the scale encountered due to using the water of Lake Erie. The feed pumps of the station are supplemented by a Hercules injector, which may be used in times of emergency. The steam piping system is covered with magnesia, and the steam passes through an Austin separator and then enters the engines. A general view is given herewith of the Woodbury engines, which are alike in size and general construction. They have cylinder dimensions of 13 x 16, and run at 245 revolutions per minute. The engines are fitted with flat balance valves, and means

Car-Barns and Rolling Stock.

are provided to lift the valves from their seats by a handle passing through the valve chest. These engines were supplied also by the Stearns Manufacturing Company. The exhaust is received in a Hardwicke water heater and then allowed to escape into the atmosphere. The engines are coupled together by short jack-shafts. Suitable clutches are provided, so that this shaft may be revolved by either engine or both, as desired. The jack-shaft is 4 inches in diameter, and carries a 6-foot pulley having a 24-inch face. Sight-feed oil cups are used. From this main pulley a 23-inch belt drives a General Electric generator. This machine is a 6–150–400 having an output of 272 amperes at 550 volts, at a speed of 400 revolutions per minute, and is of a comparatively new type. Its field magnet is of steel, and has six salient poles wound with truncated cone bobbins. This arrangement tends to reduce the leakage and concentrate the magnetic flux at the pole shoes. The armature is a toothed drum with spiral end connectors having a parallel circuit winding. Six brushes are used, and the clearance is very small. The bearings

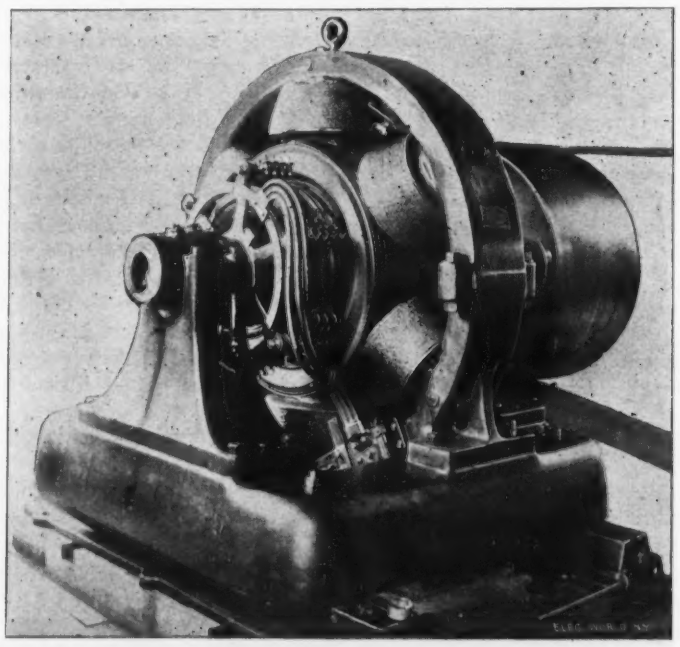


Generating Plant.

are self-oiling and self-aligning, and have never given any trouble since they were first put into operation.

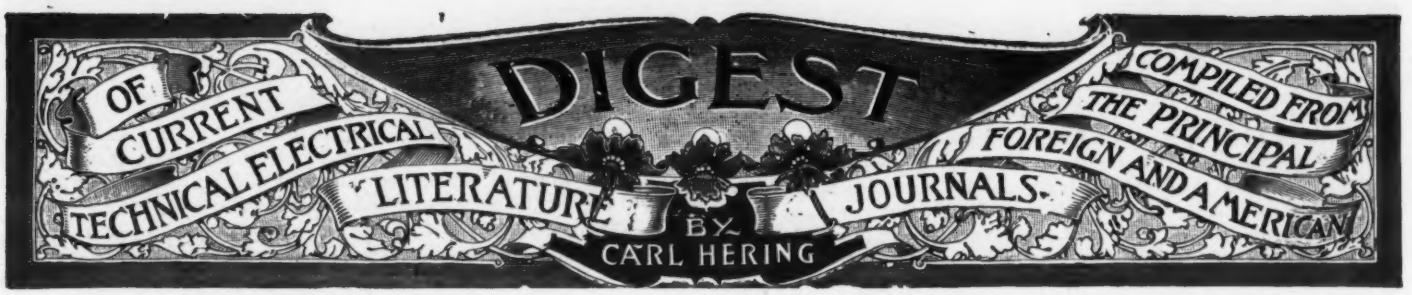
The switchboard is a single panel of the General Electric type, fitted out with a rheostat, T.-H. ammeter, two single-pole quick-break switches and a circuit-breaker. Upon a swinging arm is supported a Weston illuminated dial voltmeter. One feeder only supplies the trolley wire, which is supported on wooden poles at certain intervals.

The rail return is well bonded with Chicago rail bonds. The rails are almost all the T type which were used on the steam road. The outside circuit is protected by 10 lightning arresters. The road is four miles long, is single track and provided with turnouts. The rolling stock consists of 11 cars, six of which are motors and five are trailers. The motor equipments are all double, and consist each of a pair of General Electric-800 motors controlled by a K controller. They are mounted on Dupont trucks.



Multipolar Generator.

The cars were made by the John Stephenson Company, of New York, and are models of convenience. They have cross reversible seats, the aisle being in the centre. The car is of great breadth and well suited to the Dupont truck. An illustration shows the car-barns and rolling stock, while at the right of the picture is some of the derelict steam equipment, now scarcely worth its price as old iron and prophetic of the future of electric railroading.


DIGEST
OF CURRENT TECHNICAL ELECTRICAL LITERATURE
BY CARL HERING
COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS.

DYNAMOS, MOTORS AND TRANSFORMERS.

Dissipation of Energy Caused by Armature Currents. Lond. *Elec.*, July 24.—Several communications criticising the recent article of Bálthy (THE ELECTRICAL WORLD, Aug. 1, page 128.) SNELL thinks the interpretation of the elaborate series of experiments was not a happy one; he does not think that the assertion made at the outset with reference to the practice of dynamo designers is warranted; a point of special interest to the designers is the relative value of that "load loss" for different types; he thinks the figures should be published; he is surprised that the load loss is independent of the type of winding. SAYERS thinks that it has been long known that the losses are considerably greater than is represented by the two factors referred to; the chief losses not taken into account in Blathy's formula, he thinks are the increased magnetization of the armature under the trailing pole tips, the uneven distribution of the current density in the armature conductors under the trailing pole tips, the eddy currents in the end plates due to the field produced by the end connections of the armature, the eddy currents generated in the magnets and the resistance losses between the commutator and the brushes; he thinks light might be thrown on the matter by studying a machine with a view to determining to what extent portions of the core or supports are subject to alternating flux generated by the armature conductors in a direction divergent from the plane of lamination. HAWKINS thinks the paper does not satisfy the curiosity which it creates and hopes it will be followed by a further communication; the increase of the stray watts at full load is thought to be due to the increased hysteresis and eddy currents near the trailing pole tips, which increase may probably amount to 25 per cent. of the same losses at no load. ESSON recognizes the resistance of such a load loss, the bulk of which he thinks is due to parasitic currents in the armature conductors, attachments and field magnets; the loss is greatest in alternators and therefore cannot be due to the short circuiting of coils by the brushes; he thinks by careful designing the coefficient referred to can be reduced to unity, its proper value; he has known it to be brought down to this from 7.6.

Alternate-Current Transformers. FLEMING. Lond. *Elec. Rev.* and *Elec. Eng.*, July 24; a continuation of his lectures (see *Digest* last week).—He discusses armature reaction and its effects, describing the usual form of curves for studying the effects, and the polar diagrams (which have been described in these columns), showing the advantages of the latter. He suggests the term "form factor" of the curve, as representing the term noting the ratio between the true mean value of the curve ordinate and the "root-mean-square" value; he describes the way in which the methods for experimentally determining the form of curves are applied to studying the transformer, and gives an illustrated description of his form of non-inductive resistance (which has been described in these columns), and a number of curves showing the phase shifting, and how to calculate the induction from the voltage curve.

Alternating-Current Motors. DOBSKY. *Elec. Eng.*, Aug. 5.—A continuation of his description of some of the machinery at the Budapest exhibition (see *Digest* last week). The larger single-phase induction motors start with a greater torque; the induced part, either revolving or not, has a polyphase winding; at starting the primary acts as a diaphase winding, and the secondary is therefore preferably a three-phase one, as it gives a nearly equal starting torque in every position; the induced current is regulated by a water rheostat, which is illustrated; the starting current is never as much as that during ordinary work. He describes a simple way of starting these induction motors when any other motor of the same kind is running near at hand; the three terminals of the motor which is running are connected with those of the one to be started, and this latter will then start under full load as an ordinary polyphase motor; this is a modification and application of the phase-shifting transformer of Ferraris and Arno (mentioned elsewhere in these columns); only one motor of a group need therefore be started with the water resistance; the ordinary induction motor will stop for a large overload, but when so interconnected they will not stop, as there will always be equalizing current between the motors so connected. He describes another method of starting, devised by de Kando; the self-induction of toothed armatures depends to some extent on the number of teeth, and by dividing the primary into two parts, with a different number of teeth per unit of length, the self-induction will be different, so that if a current is sent through both it will be split up into different phases, producing a rotary field; this is carried out in practice by removing from the circuit one part of the winding located in certain notches; this is illustrated; such a motor will start nearly as a diphase motor; when at full speed the connections are changed and the current flows through every notch.

Alternating-Current Transformers. FLEMING. *Elty.* Aug. 5.—The beginning of a reprint in full of the Cantor lectures abstracted above.

LIGHTS AND LIGHTING.

Negative Resistance. S. P. THOMPSON. Lond. *Elec.*, July 24.—A short communication, under the heading of "Negative Accuracy," replying to that of FitzGerald (see *Digest* last week). Adjuvant Thomson effects are not negative resistances, nor can they be until the difference between vectors and scalers is abolished; voltage is a vector quantity, but the questionable quantity of Frith and Rodgers is the ratio of one vector quantity to another, which must therefore be scalar. A distributed adjuvant E. M. F. is indistinguishable by ordinary electric tests from a negative resistance if the negative resistance is one which varies inversely as the current; he thinks an authoritative description of the actual experiments that have led to these paradoxical results should be considered in such a discussion, and he believes that FitzGerald will, after a careful examination of these experiments, see the inherent fallacy of the method that leads to this result.

True Resistance. APPLEYARD. Lond. *Elec.*, July 24.—A brief discussion in connection with the subject of negative resistance (see *Digest* last week). He believes that it is incorrect to speak of the resistance under any circumstances, of an arc; what we call resistance is and has been derived from our experience with homogeneous metallic conductors, and its most pronounced characteristics are its independence of the currents, of the potential, and its positive sign; it may be rightly extended to substances like electrolytes and perhaps dielectrics, but when conducting mechanisms, such as gases, conductors by convection, and arcs are concerned we are not justified in predicating this quality of resistance to them, without being justified to do so by experiment; when we find that this involves the resistance having a negative sign, we should be prudent to retrace our steps and our language; without proof we are not justified in speaking of resistance in connection with the arc, in the same sense as that in which we speak of the defined resistance of a metallic conductor; at present we have no vigorous definition of resistance and the present controversy seems to have arisen from a neglect of this fact; even with a positive sign, true resistance has no proven right in equations concerning the arc.

Non-Blackening Incandescent Lamps. Lond. *Elec. Rev.*, July 24.—A correspondent signing himself as "Molecular" suggests as a theory that the deposition of the carbon is due to particles transferred from the filament to the glass by static attraction, as the filament has a much higher potential than the bulb; with an outer bulb surrounding it, the effect would be to partly insulate the inner one from the atmosphere, so that it would almost immediately be raised to the same potential as the filament; where an ordinary lamp is exposed to a draught the side on which the wind impinges would be more rapidly discharged by the air and therefore the deposit there would be greater; as a remedy he suggests the use of a metal wire in the inside of the lamp, insulated from and central between the filament, which would attract the carbon particles, the wire passing through the base and being earthed.

Illumination of Interiors. Prog. Age, Aug. 1; reprinted from *Elec. Plant.*—In the lighting of interiors sufficient attention is not paid to uniformity of illumination; the question is almost beyond mathematical computation; each case requires special treatment; observations and measurements of existing cases afford the most promising method of arriving at a good result. There are two general rules; a certain intensity of illumination should be fixed upon as necessary for the particular occupations carried on in the room; he divides the rooms into three classes, dwellings, workshops and offices (he does not state what these illuminations should be); a uniformity of illumination should be aimed at, as it is the most important question, except in cases where a high intensity of illumination is not necessary. It is shown that the commonly adopted method of distributing lights at equal distances in large rooms is not a correct one; to approximate a uniformity of illumination the lamps should be concentrated toward the outer boundary of the room (in this however he neglects the effects of reflection from the walls and ceiling); if the number of sources is to be reduced the intensity of illumination at a minimum point will be less, or if it must be the same the total candle-power of the fewer sources must be greater.

Diminution of Light Through Opal Globes. *El'ty*, Aug. 5.—A brief abstract of the article by STORT, which was noticed in the *Digest*, Feb. 1 and Sept. 7.

POWER AND HEAT.

Transmission Plant in Mexico. HENRY. *Jour. of El'ty*, May.—A brief, illustrated description of a hydraulic electric power-station for long-distance transmission in the State of Hidalgo, about 100 miles north of the City of Mexico; the head is 800 feet; three-phase generators are used; the voltage will be 10,000; the line consists of three 0000 B. & S. copper wires; it is intended to supply power to one of the most extensive mining organizations in the world, to a maximum distance of about 23 miles and a mean of about 18 miles; it is claimed that the entire outlay, some $3000, will be returned to the company in two years by the saving in the fuel.

Mining Transmission Plant. *Jour. of El'ty*, May.—A brief description of the plant of the Utica Mining Company, which has the largest output of gold of any of the gold mines in California; the plant, it is thought, will be one of the largest mining installations in the world; about 3000 horse-power will be generated and sent over a distance of 8.5 miles; "the system will consist of two-phase generation, three-phase transmission and various distributions"; the line voltage will be 10,000.

Monocyclic Distribution Plant. *Jour. of El'ty*, May.—An illustrated description of the plant at Middletown.

Zufikon-Bremgarten Three-Phase Plant. *West. Elec.*, Aug. 8.—A brief, illustrated description of the plant referred to in the *Digest*, April 18 and 25.

Power Plant at Austin. *Sc. Amer.*, Aug. 8.—An illustrated description of the large dam at Austin across the Colorado River, at which 14,639 horse-power are developed, portions of which are to be used for electrical purposes.

Electric Fire Pumps for Mills. NEWCOMB. *Cassier's Mag.*, August.—A short article suggesting what he considers an ideal plant, consisting of a pump at a safe distance from the mill, capable of starting automatically and driven by power independent of the mill, this being made practical by the use of electric power; a sprinkler system would be connected with a regulator so that a fire would operate some of the sprinklers under the influence of the heat, which would diminish the water pressure, this in turn acting on the regulator which starts the motor and the pump.

Power for Machine Tools. SUMMERS. *Elec. Eng'ing*, August.—An article giving a collection of some experimental data showing the power consumed by machine tools, from which the size of electrical motors for driving them can be determined; it seems to be taken largely if not entirely from recent articles in the *Amer. Machinist*, noticed in the *Digest*, Aug. 1.

Electricity in Mining. PHELPS. *Elec. Rev.*, Aug. 5.—A short article of a general nature pointing out the advantages of electricity for this purpose; it seems to contain nothing new.

The Future of Power Development. STRONG. *Cassier's Mag.*, August.—A short article in which he argues in favor of the gas engine; among other things he thinks it will also be used as a locomotive, in the future.

TRACTION.

Lightning Express Trains. BEHR system. *Elec. Eng.*, July 24.—A brief, illustrated description of a model, the illustration showing a cross-section of the car. The system, which has been before the public for several years, is intended for speeds of 100 to 150 miles per hour; the distinguishing feature is the use of one elevated rail on which the car runs, the wheels being about in the centre of the car, vertically; it appears that four guide rails below the central weight-bearing rail are required; each car will have its own driving power; a trial track is being constructed at Brussels for the exhibition next year; it will be 3.125 miles long and will be oval in form; the guaranteed speed is 95 miles per hour on curves of a radius of 550 yards; the mechanical stresses under these conditions are editorially thought to reach an alarming amount, the centrifugal force reaching the figure of 20 tons, which is to be taken by the guide wheels; the pressure on both sides is intended to be equal; the carriages are quite long and are made of two or more parts joined together by pivots, each part being supported by two driving wheels; the centre of gravity is kept below the level of the line rail by placing the motors at the bottom; the carriage body cannot move laterally, although it is supported on springs.

Electrical Autocars. Lond. *Elec. Rev.*, July 24.—A note stating that recent improvements in accumulators made by King brings these batteries within the bounds of successful application in some cases; a three-hp battery now weighs 1,300 pounds and occupies 9.5 square feet of clear space; a three-hp motor weighs 60 pounds per horse-power; (nothing regarding the maximum rate of capacity of the battery is given).

Gas-Driven Railway Cars. Lond. *Elec. Rev.*, July 24.—A brief description, without illustrations, of the Luehrig system, which has been in use for nearly two years in Dresden and Dessau (Germany) and which has now been installed at Blackpool, England.

Traction Diagrams. TOMLINSON. Lond. *Elec. Rev.*, July 24—A continuation of his serial (see *Digest* last week). He discusses the subject of losses due to grades and the drawbar pull due to the combined effects of gravity and friction; two diagrams are given showing the drawbar pull while going in one direction and then while going in the other, showing how the mean pull for the double journey can be calculated. (This series of articles is praised very highly by Mr. Crompton).

Conduit System. *West. Elec.*, Aug. 8.—A brief description of a model of the MUNSON system in which there is a slotted conduit of small depth, with a very narrow opening, containing contact points every 20 feet operated by switches in water-tight chambers.

Surface Contact System. *Elec. Jour.*, July 15.—A reprint with illustrations, of the description of the PRINGLE and KENT system noticed in the *Digest*, July 18.

Third Rail Conductors. DAFT. *Elec. Eng.*, Aug. 5.—A short, illustrated description of some of his earlier experiments with third rails.

The Pull of a Horse. *El'ty*, Aug. 5.—A reprint of the article noticed in the *Digest* last week.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

New System of Electric Distribution of Energy. FERRARIS and ARNO. *L'Eclairage Elec.*, July 4.—An article describing their new system, accompanied by a number of diagrams and illustrations. A brief description of this system was given in the *Digest*, June 6, and a reference to a translation in abstract in the *Digest*, June 13; this appears to be the first description published by the authors themselves.

Graphical Calculation of Regulator Resistance. STADELMANN. *Elek. Zeit.*, July 23.—An illustrated description of a comparatively simple graphical method for determining the resistance, the current and the voltages; it does not admit of being abstracted; curves are given illustrating the application to adjustable resistances for various purposes.

Fallacy of Municipal Ownership of Franchises. LOOMIS. *Eng. Mag.*, Aug.—He argues that municipal control as distinguished from legislative control and from municipal ownership, is the true solution of the municipal monopoly problem.

Municipal Ownership. *Prog. Age*, July 15.—An unfavorable editorial discussion of a recent paper by PERSSE, read before the New Haven Street Lighting Convention.

WIRES, WIRING AND CONDUITS.

Calculations of Conductors. GOSSELIN. *L'Eclairage Elec.*, July 11.—A criticism of the recent paper of BOCHET (see *Digest*, Aug. 1), in which the calculations are based on a minimum of the total expenses as distinguished from the cost of the copper; some of these expenses are not proportional, and the problem may therefore be solved graphically by drawing curves representing the variations in the cost of each element, and on finding the minimum by adding together all the ordinates which would give a curve with a minimum point.

Niagara-Buffalo Transmission Line. *Elec. Eng.* and *Elec. Rev.*, Aug. 5.—An illustrated description of the details of this line, a brief description of which was given in THE ELECTRICAL WORLD, Aug. 8.

ELECTRO-PHYSICS AND MAGNETISM.

Alternating Current Rushes in Condensers. SCATTERGOOD. Lond. *Elec. Rev.*, July 24.—A continuation of his series of articles (see *Digest* last week). He further illustrates the hydraulic analogy, showing also the oscillatory character of the charging current, from which it appears that there is not necessarily a reversal of the direction of the current but only a fluctuation in its strength, while at discharge there is also a reversal of the sign of both the voltage and the current; the analogy is thought to be quite complete. He gives the results of actual measurements of the increase of current shown by the lamp, as described last week; with a dynamometer in series with the lamp the current, when there was no spark gap, was about 0.17 amperes and the voltage was estimated at about 30; with the spark gap opened as far as possible, the voltage was estimated at 110 to 130 and the current actually fell to 0.05 amperes; in the first experiment the lamp consumed about five watts, the illumination being a small fraction of a candle, while in the second case it consumed six watts, generating not less than 20 candles; a production of 20 candles with six watts was thought to be too good to be true and he therefore endeavored to find where the error lay; the power factor in that case would be greater than unity; a number of different instruments were used with which the measurement was repeated; somewhat similar results were obtained except that the current was not less than for no spark gap; the most probable explanation is the existence in the circuit of E. M. Fs. of high frequencies; he suggests that there may be eddy currents in the frame work of the instruments; the article is to be continued.

X-Rays. Lond. *Elec.*, July 24.—A brief note stating that, according to Jackson, the light emitted by the platino-cyanides, under the influence of X-rays, when examined by the spectroscope, proves to be a light corresponding to the element which forms the base of the compound; this in connection with the Helmholtz investigation of 1893 (mentioned below), is thought to be a point of the utmost significance, since it shows that we are dealing with vibrations, not of the molecules, but of some of the constituent atoms. Prof. S. P. Thompson recently stated that X-rays can apparently touch the atom within the molecule, setting it into vibration.

Hyperphosphorescence. S. P. THOMPSON. Lond. *Elec.*, July 24.—A reprint in full of the article abstracted in the *Digest*, July 25.

Electromagnetic Theory of Dispersion. VON HELMHOLTZ. Lond. *Elec.*, July 24.—A translation in full of the paper published in the *Wied. Ann.*, Vol. 48, pages 389 and 723, 1893. (This appears to be the article referred to by Lodge in the *Digest* last week.)

Atmospheric Electricity. CHREE. Lond. *Elec.*, July 24.—An abstract of a Royal Society paper referring to observations at the Kew observatory. The object of the investigation was to arrive at a more exact interpretation of the records obtained with the Kew electrograph and to devise improvements if possible; Exner's theory is discussed; it connects potential gradient with the density of aqueous vapor through a definite formula; the results of the investigation seem far from favorable to this hypothesis; the scope of the observations was not sufficiently extensive to warrant the adoption of any positive conclusions as to the true operating cause of variations of potential.

Discharging Liquids by Vapors. SCHWALBE. *Wied. Ann.;* mentioned in the Lond. *Elec.*, July 24.—He proves that vapors arising from an electrified liquid are incapable of discharging it or conveying away any portion of the charge.

Arc Between Mercury, Amalgam and Alloy Electrodes. ARONS. *Wied. Ann.*, Vol. 58, page 73; abstracted in the *Elek. Zeit.*, July 23.—A description of his experiments with such arcs.

Magnetic Bodies. COHN. *Wied. Ann.;* noticed in the Lond. *Elec.*, July 24.—He discusses magnetically hard and soft bodies; the former being those which hinder the propagation of a magnetic field and the latter those which permit it; a solution of ferric chloride, which may be regarded as absolutely soft iron, exerted no influence on the propagation of a field due to a current; soft iron also proved to be a magnetically soft body; steel diminishes the field, especially for weak currents; the experiments were made by passing a conductor carrying a current, through hollow cylinders made of various substances.

New Magnetic Phenomenon. DUANE. *Wied. Ann.;* noticed briefly in Lond. *Elec.*, July 24.—The author (an American), found that discs and cylinders of glass, sulphur, ebonite, paraffine or quartz, when suspended between the poles of a strong electromagnet, with the axis at right angles to the lines of force, experienced a decided damping of their oscillations; the effect was not due to induced currents and is at present unexplained; it was the same whether the bodies were paramagnetic or diamagnetic.

Contact Resistance. WIRT. *Elec. Eng.*, Aug. 5.—He shows the great difference in the contact resistance between surfaces at rest and in motion, and gives data regarding the former by way of comparison with that in a recent article on commutator resistance (see *Digest*, July 11 and 18). Some years ago he carried out some rather crude experiments in the Edison laboratory with two circular contact blocks of red brass, two inches in diameter and one inch thick, measuring the contact resistance and the pressure. Between 25 and 250 pounds per square inch the resistance varies inversely as the pressure; the total pressure remaining constant, a reduction in the area does not alter the resistance within wide limits; the pressure and area remaining constant, variations in the perfection of the fit produces but slight, if any, change in the resistance; clean petroleum between the surfaces does not greatly alter the resistance; the same is true when the oil is mixed with pure graphite; a washer of thick tinfoil between the contact surfaces gave a resistance for the double contact not greater than the single contact of the blocks with each other, except with light pressures. The surfaces were fitted until they adhered by suction; the slight effect of oil was surprising; it appears that there are only a few contact points, their number being increased under pressure, and that these points are able to displace the liquid film; he suggests making more careful experiments; in unsoldered connections the conductivity depends within wide limits not on the area of the contact but on the pressure, a rule which he says is at variance with practice but is undoubtedly true; large contact surfaces are of value for radiating surfaces and for proper conductivity without undue pressure which might be sufficient to cut; where a heavy pressure can be secured, the area of contact may be safely reduced to the amount required by mechanical consideration; a washer of tin protects joints from the effects of corrosion.

X-Ray in Surgery. GREENO and HORNSBY. *Elec. Jour.*, July 15.—A short article intending to show that the achievements with the aid of the X-rays have not justified the expectations, and it is thought doubtful whether all the pictures that have been published were honest; they state that the only real use which they know of for the X-ray, is in the location of bullets, needles, etc.; they describe their own lamentable failures.

X-Rays in Medical Diagnosis. Elec. Eng., Aug. 5.—An abstract from the London *Lancet*, describing results shown at the recent surgical congress at Berlin. Screens of platino-cyanide of barium were used; the results indicate the probable value in the very near future of the X-rays in diagnosing certain conditions, and are claimed to be far in advance of anything that has yet been achieved. The images seen while passing the rays through the head, neck, chest and stomach are described; among other things it is stated that the heart appears as a shadow, intensely black in its central part, and with a light periphery; its movement is distinctly visible, chiefly at the apex; on close examination the movement of the aorta may be noticed also; the limits of the stomach may be well seen, especially after it is distended by an effervescent mixture. The rays have already been used for confirming previous methods of diagnosis, and afford means of ascertaining certain symptoms with some precision, which would not be indicated by the present methods.

Limiting Distance for Making Radiographs. GREENO and HORNSBY. *Elec. Jour.*, Aug. 1.—A reproduction of three exposures of a fish taken under exactly the same circumstances except that the distance was increased each time, the object being to determine whether there was a distance beyond which the rays would not act on the plate; they conclude that the range is very limited; they are convinced from the results that with the present methods it is not possible to show a metallic body in the adult trunk or to outline the bones in that part of the body.

Tesla Apparatus for Radiography. Elec. Rev., Aug. 5.—A reprint with the illustrations, of the apparatus noticed in the *Digest*, Aug. 1.

Hypothesis Concerning the X-Rays. LODGE. *El'ty*, Aug. 5.—The beginning of a reprint in full of the article abstracted in the *Digest* last week.

Conductivity of Salts Dissolved in Glycerol. CATTANEO. *Elec. Eng.*, Aug. 5.—The conductivity of the various salts examined is in general greater than that of the corresponding ethereal solutions but less than that of the alcoholic ones; in all it increases more rapidly than the concentration; the temperature coefficients are usually greater for aqueous than for alcoholic solutions. In a table of the conductivities of glycerol he shows that those carbon compounds which became most viscous on cooling are those whose conductivity increases most rapidly as the temperature rises.

Theory of Sheet Lightning. SMITH. *Pop. Sci. Mo.*, August.—A brief abstract of a paper on thunder storms in India. It is seen in Madras every evening for six months; it is not a reflection of distant lightning flashes, but consists of an actual discharge of electricity from cloud to cloud or between two portions of the same cloud, and takes place in the upper portions of low-lying clouds; the time of occurrence depends on when the sea breezes set in, the lightning taking place about three hours later; he thinks the electrical conditions of the clouds may be accounted for by the fact that the sea breeze is moist and dusty while the land breeze is dry and dusty.

Theory of the Structure of Matter. ALDEN.—A pamphlet explaining the author's theory, which is based on the assumption that an atom of matter consists of a vortex ring of luminiferous ether; it was developed by studying how the mechanical effects which such rings would produce would correspond with the known phenomena of matter; it contains some references to electrical phenomena.

Electric Repulsion. OSMOND. *Elec. Eng.*, Aug. 5.—He questions the correctness of saying that two like charges repel each other and thinks the apparent repulsion is due to attraction to other neighboring bodies of unlike electrification; his ideas are endorsed editorially by that journal.

Dielectric Constants. RATZ. *Zeit. f. Phys. Chem.*, abstracted briefly in the *Elec. Eng.*, Aug. 5.—He shows the dependence of these constants on temperature and pressure; the pressure coefficient is small and positive and the influence of temperature is greater and that of pressure less than the calculated effects.

ELECTRO-CHEMISTRY AND BATTERIES.

Velvo-Carbon Primary Battery. ALLINGHAM. Lond. *Elec. Rev.*, July 24; a student's paper read before the Institution in December, and rewritten for the present paper.—He describes the battery in some detail, giving results of experiments, and comparing it with other cells. The chief novelty lies in the negative electrodes, which consist of carbon rods, around which have been wound strips of velvet, the whole being then carbonized, thus forming rods covered with innumerable small filaments which facilitate the escape of the hydrogen; they are used preferably with sulphuric acid, although they will work well in bichromate and other solutions; in the two-fluid bichromate type the cost of the depolerizer is about three quarters of the whole cost of recharging, the other fourth being for zinc and sulphuric acid; the useful voltage of the velvo-carbon cell is 0.5 and 0.6 volt, so that two, or at most three, will replace a Bunsen or bichromate cell; thus the total cost of recharging is not much more than half that of a Bunsen cell. The zinc gives over 300 ampere hours per pound, the theoretical being 370, and nearly two pounds of acid are required per pound of zinc; one kw-hour at 0.55 volt will require less than six pounds of zinc and 12 of acid, which with amalgamation amounts to 87 cents per kw-hour; on a large scale it is claimed that the cost would only be about half as great. After an initial fall of voltage the current is quite steady, as shown by diagrams. A brief comparison is given with the Lalande copper oxide cell, the chief advantage of which is that the zinc is not consumed on open circuit; when the velvo battery is charged with acid of 25 per cent. or 1.180 sp. gr., for strong currents, the zinc must be removed when not in use, but with weaker acids, such as are used for smaller currents, the zincs may be left in the liquid for many weeks; the battery will also work with caustic potash if only weak currents are required; he considers this the best battery, as it is the most economical and the simplest to manipulate; for

less than one horse-power, engines become very inefficient and the primary battery then becomes practicable; he thinks it hardly if at all more expensive to run a launch on the Thames with primary than with secondary batteries, as the cost of charging the latter is high. One of the faults of all primary batteries is their bad regulation and for lighting therefore it is usually advisable to charge accumulators with them; the useful voltage of the accumulators may then be higher than that from the primary cells direct, if the latter can be made to charge them slowly, as the loss of voltage for the primary cells when used directly is quite great; five and six cells will charge a storage battery rapidly while three are enough to keep it fully charged. Carbon electrodes are platinized by rubbing the solution into the velvet before it is carbonized; the cost of this is only one cent per rod; for plates it is preferable to use a number of carbon rods fastened together in the form of a plate; ordinary arc light carbons are used; the normal current obtainable is about 0.5 ampere per foot of rod nine mm in diameter, at which rate of discharge the useful voltage is about 0.5; the connection with the carbon rod is made with a silver wire costing a quarter of a cent, which is wedged into a hole by means of an ebonite rod; the zinc electrodes are made of No. 16 gauge sheet zinc, well amalgamated; the carbons never need replatinizing; an important advantage over the Smee cell, of which this is a modification, is that when the mercury which may have been dissolved from the zinc plate is deposited on the cathode, it ruins it in case of a Smee cell, while with the carbon electrodes a short exposure to the air will oxidize the mercury, which will then be dissolved.

Polarization with Alternating Currents. Wien. *Wied. Ann.*, Vol. 58, page 37; abstracted in *Elek. Zeit.*, July 23.—According to Kohlrausch, when an alternating current passes through a liquid a new periodic E. M. F. is set up, from which it follows that the action of such a liquid can be reproduced by a metallic resistance in series with a condenser; the present author proves that while the first statement is correct the resistance is always larger than that calculated from the dimensions and conductivity of the liquid conductor; there is therefore an additional resistance which diminishes approximately proportionately to the surface of the electrodes and the frequency, and under certain conditions can have a very appreciable value. For measuring the resistance of electrolytes according to Kohlrausch's method, when using platinum electrodes and low frequencies, the measured resistance may be much greater than the true resistance; it is much better to use platinized electrodes and high frequencies. He also discusses the error produced by polarization in the determination of the dielectric constants of conducting dielectrics and arrives at the conclusion that the "electromotive" method of measuring with alternating currents, especially by using an electrometer needle of platinized platinum, is much superior to the bridge method.

Production and Utilization of Ozone. Lond. *Elec.*, July 24.—A brief reference to the latest devices of Andreoli, at present exhibited in London; in one of these there are rows of points with no intervening dielectric other than air; in the other an electrode is enclosed in a vacuous glass envelope surrounded by concentric rings with radial points toward the axis of the tube, this annular structure constituting the other electrode and the air being passed between the points and the outer surface of the glass envelopes; no further description is given. It is spoken of unfavorably, as it is thought that the object in ozone apparatus is to avoid all contact of the ozone with any oxidizable material; proof is required that the departure from these recognized principles is an advantage.

Processes for Nickel-Plating Wood. Lond. *Elec. Rev.*, July 24.—Brief summaries of a number of processes from *Dingler's Journal*, 298, page 72; they are given only very briefly in the abstract.

Products of the Electric Furnace. Moissan. *L'Eclairage Elec.*, July 11.—A brief summary showing the behavior of a number of metals and compounds.

Validity of the Cyanide Patents. Wells. *Eng. Mag.*, August.—An article showing the increasing importance of the cyanide process in gold extraction, and pointing out that in the patent for the use of cyanides and in the one covering the use of zinc to precipitate the gold, the patentees are claiming discoveries that were published long prior to their patents.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Determining Alternating-Current Curves. Michalke. *Elek. Zeit.*, July 23.—After referring briefly to the importance of determining these curves and to the discussion in The Electrical World some two years ago, regarding the best form of a current wave, he describes the apparatus made by Siemens & Halske, for determining such curves. It is essentially the method proposed by Blondel, in 1891; a contact disc is used and is rotated by a synchronous motor, thus enabling the apparatus to be used at any point of a circuit; the stationary inducing winding of the motor has a three-phase winding connected by the star or the triangle system; the winding of the other part is connected according to the star system, the ends leading to three slide rings; one of these latter windings is short circuited while the two others are short circuited only for starting the motor; at normal speed these two windings are supplied with a direct current, the third remaining short-circuited; by this arrangement the motor runs synchronously, which is a very necessary condition; the connections for the motor are shown in an illustration; while a curve is being taken the excitation of the motor must not be altered as it would change the phase; a disc with black and white sectors illuminated by an alternating arc-lamp connected with the same circuit, is used to determine the point of synchronism; the rotating disc contains three insulated rings, the middle one projecting at one point into one of the outer ones and at another point into the other, like on the usual alternating-current commutators, except that one projection is narrow and the other wide, the former being used for charging a condenser and the latter for discharging it through a galvanometer; the brushes may be moved for determining different points of the curves; constant current is obtained in the galvanometer, which is proportional to the charging voltage; this is also true if the galvanometer circuit contains a high resistance with or without self-induction, but it is then no longer proportional to the capacity of the condenser; experiments show that in using mica condensers a time of charging of 0.0002 seconds is sufficient, which for a frequency of 50 corresponds to 3.6 degrees of a period; by the use of a proper switch the curves in different parts of a circuit can readily be measured, as also the current and voltage curves of the same circuit. The zero method may also be used by placing an adjustable E. M. F. in the circuit, which may be made to compensate that obtained from the alternating current; in this case a telephone may be used instead of a galvanometer. For high voltage circuits only a portion of the voltage can be used, and in that case it is suggested to use the middle portion of a circuit as the potential with reference to the earth as the lowest and therefore the safest; for practical purposes intervals of five degrees are sufficient. A number of curves thus obtained are given, as also an illustration of the apparatus.

Photometry. L'Eclairage Elec., July 11.—Abstracts of a number of papers read at the Carthage meeting of the French Association for the Advancement of Sciences. Blondel and Broca gave a description of their universal photometer for measuring intensity, illumination and brightness, the latter both for distant and for near sources; a diagrammatic illustration is given; it is thought that the measurements may be made to within half a per cent. Broca read a paper on the conditions to be realized in photometry, which is briefly noticed. Broca read a paper on the use of a napthaline lamp as a secondary standard; he found that this lamp, otherwise known as the albo-carbon lamp, has a very constant intensity if the temperature is kept constant; the errors do not exceed 3 per cent. when no other precautions are taken than to avoid drafts and to keep the temperature of the room about 15 degrees C.; two or three degrees difference is not of much importance; it is regulated up to the point at which it becomes smoky, at which time one can depend on its constancy; it is thought to be quite an exact standard if the reservoir is placed in a bath of oil kept at a standard temperature. This standard is well adapted to test photographic plates, as its rays are actinic and are quite intense. Fery read a note on the acetylene photometer, a brief mention of a part of which is given; this refers to an apparatus for easily measuring intrinsic brightness with the ordinary apparatus in a laboratory; as a unit of comparison he takes the central portion of the flame of a Carcel lamp; the light passing through a small hole is used for comparison; a secondary standard of comparison is used, but in what way is not clear from the abstract; a table is also given, showing apparently the brightness of different parts of various sources of light, compared with the Carcel as a standard. Violle described his acetylene standard. Guillaume read a note on a unit of brightness; as a theoretical unit might be taken the number of watts expended in the bands of the spectrum defined by the condition that the lengths of the waves of these radiations differ 0.1 for instance; such a union would be difficult to apply but it seems the only rational one; he discusses the faults of the present standards, the best of which is that of Violle. Chassevant read a note on a process for regulating the generation of acetylene by the action of the water on the carbide; it consists in adding alcohol in suitable proportions; it counteracts to a certain degree the affinity of the carbide for the water; it is thought that this might be useful in connection with the acetylene standard. Violle read a paper on the electric arc, which is very briefly noticed. It refers to the temperature of the vaporization of carbon. Pluvinel read a note on quantitative photography, showing how the luminous intensity may be measured by the amount of silver affected; he also shows that certain accepted ideas regarding photographic sensitiveness are quite false; the effect produced is not at all constant when the product of the illumination and the time of exposure is a constant.

Measurement of High-Frequency Currents. Meylan. *L'Eclairage Elec.*, July 11.—An article which seems to be an elaboration of the one abstracted in the *Digest*, June 20; he shows some phenomena which were observed with the new apparatus for measuring such currents; the apparatus itself is described; it is a thrmal instrument. Among his conclusions he states that by means of such a thermal galvanometer he showed that a fraction of a current, about 8 to 10 per cent., is returned to the secondary circuit of the induction coil; there is a greater dissipation of energy when the frequencies are low; condensers become more heated for low frequencies; with this instrument he verified the proportionality between the mean volts taken in derivation from one or more spires; and the E. M. F. indicated in an isolated spire, whatever be the

source or the adjustment of the interrupter; he verified the ordinary law of derived currents when the resistances are inductionless.

Thermal Instrument for Measuring Currents. FRIESE. *L'Eclairage Elec.*, July 11; an abstract of a paper from the German.—He shows the advantages of thermal instruments for measuring both alternating and direct currents, and describes one devised by him, which appears to consist of a stretched wire attached to a lever, the other end of which is attached to a Ayrton & Perry spring (which tends to rotate on being elongated) at the end of which there is a mirror; no illustration is given.

Self-Induction Coils. WIEN. *Wied. Ann.*; noticed in the Lond. *Elec.*, July 24.—He describes the construction of coils made of copper wound on serpentine; they are claimed to be accurate within one tenth of a per cent., and are practically uninfluenced by time and ordinary changes of temperature.

Localization of Faults in Electric-Light Mains. RAPHAEL. Lond. *Elec.*, July 24; a continuation of his serial (see *Digest*, July 25).—He describes and discusses in detail the application of Varley's loop method.

Quadrant Electrometer. DOLEZALEC and NERNST. *Elek. Zeit.*, July 23.—A reprint, with the illustrations, of the article abstracted in the *Digest*, Aug. 1.

Davy-Faraday Research Laboratory. Nature; abstracted in the Lond. *Elec.*, July 24.—A brief description of the laboratory endowed by Dr. Mond for physical and chemical research, to be known by the above name.

Determining the Motion of Projectiles Inside of a Gun. CREHORE and SQUIER.—A reprint, under separate cover, of the article from the *Journal of the U. S. Artillery*, Vol. 5, No. 3, describing the application of the polarizing photo-chronograph; it is the complete article of which an abstract was given in THE ELECTRICAL WORLD, June 27.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Efficiency of Translators. BREISIG. *Elek. Zeit.*, July 23.—A short criticism of the article of Witlisbach (see *Digest*, Aug. 1, and May 16), calling attention to what he considers to be some errors; he thinks that sufficient importance was not given to the fact that the two windings of a transformer are dependent on each other in their electrical relations; to place a dynamometer first in one and then in the other circuit is not correct, as it produces changes in the circuits; he gives numerical examples illustrating the point which he makes and intends at some future time to give a report of measurements made by a method which is not open to these objections.

Accumulators in Telegraph Work. HALL. *Elec. Jour.*, Aug. 1.—A brief illustrated description of the plant at Wilmington, Del., for the fire alarm and police service.

First Principles in Railroad Signalling. PAINE. *Eng. Mag.*, August.—An illustrated description of several different systems.

MISCELLANEOUS.

Action of High Frequency Currents of Toxines. D'ARSONVAL and CHARRIN. *L'Eclairage Elec.*, July 11.—An abstract of some length of a recent Academy paper giving the results of experiments; they found that high frequency currents act so as to dilute the toxines of bacteria and that the toxines so treated increase the resistance of animals which have been injected with them.

International Congress at Geneva. S. P. THOMPSON. Lond. *Elec.*, *Elec. Rev.*, *Elec. Eng.*, July 24.—A communication showing that the English societies and Government were not notified officially and that therefore the congress cannot claim to be international; and decisions derived by it can carry little weight internationally, and England is justified in disclaiming, beforehand, all responsibility for the acts of such an informal congress.

German Union of Electrical Engineers. Elek. Zeit., July 23.—The conclusion of the report of the recent annual meeting; it refers almost entirely to business matters, including only a brief description of the new factory of the General Electric Company, of Germany; none of the papers are abstracted, as they will be published in full in that journal.

Progress During the Past 50 Years. Sc. Amer., July 25.—In a long, illustrated article in this, the fiftieth anniversary number of that journal, there are portions devoted to the telegraph, telephone, submarine cable, and the generation and application of electrical energy, each giving a brief summary of the state of the art 50 years ago, and the progress up to the present time.

Cost of Carbide of Calcium. Prog. Age, July 15.—A reply of Houston, Kennelly and Kinnicutt to some of the criticisms of their recent report to that journal; those referring to the criticisms of *Electricity* are reprinted in that journal July 22, and are replied to editorially.

Era of Extravagance in the Electrical Business. GREENE. *Eng. Mag.*, August.—A short article showing that the present indications promise stability and profit.

Biographical. Cassier's Mag., August.—A full-page portrait, with a brief biographical sketch, of CHARLES FRANCIS BRUSH.

Organic Membranes as Insulators. RICHARDSON. *Elec. Rev.*, July 29.—A reprint from the Lond. *Lancet*, in which he shows by experiments that various membranes of the animal body are also electrical insulators and confine the currents developed to the organs which they surround.

New Book.

ELECTRO-DYNAMIC MACHINERY FOR CONTINUOUS CURRENTS. By Edwin J. Houston, Ph. D., and A. E. Kennelly, Sc. D. New York. The W. J. Johnston Company. 1896. 331 pages, 232 illustrations. Price $2.50.

This book stands out from all other treatises on the subject by reason of the lucidity, consistency and freshness of its treatment. In it the general principles which underlie the design and action of dynamo-electric machinery have been set forth in a manner almost beyond criticism, and it is to be remarked that though a careful inspection shows there has been no shirking of difficult topics, yet the presentation has been so made as to be readily comprehended by those who have no knowledge of the higher mathematics.

Experienced authors both of them, the collaborators of this book, of one of whom it has been said by a prominent transatlantic engineer, "Of all the beautiful expositions of profound mathematical work in the simplest language, which can be understood by any student of our technical colleges, there is nothing in the literature of the day to come up to the recent writings of Mr. Kennelly,"—a certain amount of their success is, no doubt, due to that ease and directness of accomplishment which is in every craft the result and reward of long practice.

Yet in larger measure even, it may be attributed to another cause. Here for the first time in a technical treatise has the general equation of the magnetic circuit been presented in a form analogous to that of Ohm's law. It is true that the idea and expression, "closed magnetic circuit," were originated many years ago by De la Rive, and have since been elaborated by Rowland and others, but, if we except some papers in the technical journals, the coefficient of permeability has always been used instead of the more natural idea of reluctance.

The formula, "Amperes = Mhos × Volts" is not nearly so familiar to the average electrician as the "Amperes = Volts ÷ Ohms." Consequently if, as do Hopkinson and other writers, we use the formula which expresses the fact that the magnetic flux is the product of $.4\pi$ times the ampere-turns and the permeance, the idea is not nearly so readily grasped as through the Ohm's law analogue used in this book, *i. e.*, Webers = Gilberts ÷ Oersteds.

That the gain from this simplification is not a slight one may be judged from the writer's experience, where the adoption of this idea and of the Institute units led to the unexpected result that work on dynamo-electric machinery and electro-magnetic devices, which formerly occupied the time of the students during 30 weeks, was after the change in method completed in 20, and that with the much more important result that there was a marked gain in the thoroughness of the knowledge obtained.

A perusal of the book itself is, however, the best argument which could be made in favor of the author's method. Any one who can comprehend Ohm's law will find no difficulty in understanding Chapters 4, 5, 6 and 12, after which he will find it a comparatively easy matter to make the calculations for any form of magnetic circuit met with in practice.

The subjects treated of, are, in order: General Principles of Dynamos, Structural Elements of Dynamo-Electric Machines, Magnetic Flux, Non-ferric, Ferric and Compound Magnetic Circuits; Laws of Induction, Induction in Armatures, Voltage in Armatures, Pole, Gramme, Drum and Disc Armatures; Single, Two and Multipolar, Machines; Hysteresis, Eddy Currents, Heating of Dynamos, Armature Reaction and Sparking at Commutator; Regulation, Motor Torque, Regulation and Efficiency; Starting and Reversing of Motors, Motor Meters and Motor Dynamos. From this it will be seen that the subject is treated of quite comprehensively, and many important details are given which have not hitherto appeared in works on the dynamo.

Having called attention to the good points of this book, its few defects may be mentioned. In the first place, as regards nomenclature. Since the Institute units have been adopted, there does not seem to be any valid reason why the term magneto-motive force should be used instead of the shorter, and more correct term, Gilbertance. Magneto-motive force is a vile term, because the thing itself is not a force and it has nothing to do with any actual motion of magnetism. It is a potential and we are absolutely certain that there is no actual flow of magnetism, for μ is analogous to k and not to conductivity (*vide* the remarks of Gray and Heavyside on this subject). There is also no reason why voltage should not be used instead of electro-motive force, which is also misleading, because its name would incline one to think it a force, while it is really something altogether different, *i. e.*, a potential.

In Section 350 the reason given for the advantages obtained with multipolar machines may be questioned. Any given armature will give the same voltage and power whether in a two or multipolar field, provided, of course, the same percentage of the armature is covered by the pole and they have the same flux density. The gain is not in output, but in the fact that less iron is used in the magnetic circuit, and the size of the whole machine is reduced. Similarly not all will agree with the statement on Section 112 that the wire passing over the ends of the armature is

not to be considered as idle wire. This statement is very generally made, but seems to the writer to be incorrect for the following reasons: If we have two coils of equal length of wire the square coil will undoubtedly enclose and cut a greater flux *per revolution*, but the square coil *cannot make so many revolutions per second as the oblong one*, since for mechanical reasons the limiting peripheral speed is the same in each; and the loss from this latter cause is greater than the gain from the former, so that in practise for mechanical and not electrical reasons we must consider the end wire as idle.

It may be noted that when we take this fact, that the limiting peripheral speed must be the same for all machines, we obtain the correct formula connecting the output and weight of machines, though, of course, fads like the present one for slow speeds may slightly modify the results.

The only error in the calculations given which the writer has been able to find is that in Section 162, where the leakage lines are not added to the yoke lines, to give the total yoke flux.

As regards the validity of the criticisms made, there may be difference of opinion, as the points are more or less debatable, but as regards the merits of the book it is believed that there will not arise any question.

A New Arc Lamp.

The W. D. Graves Electrical & Machine Company, Cleveland, O., is putting upon the market a new arc lamp which embodies all of the improvements in arc lamps up to date and at the same time has the simplest of mechanisms. A description of it will be interesting.

In Fig. 1 is shown the lamp mechanism. The clutch, which operates on the washer principle, as indeed do almost all clutch feed lamps, is quite novel. A little rectangular frame of a single brass casting forms the body. The clutching part consists of two bars of finely finished steel, which are driven through holes in the sides of the rectangular frame and form two sides of the inner rectangle. The feed-rod passes through this rectangle, which is tilted by the magnet so that the steel bars bind on the rod and feed it as required. The feeding mechanism consists of a frame tilting in bearings. A spiral spring keeps the clutch normally open and the carbons run together. On the right side of the tilting frame as shown, is the armature, which is actuated by a simple series magnet. This magnet both lifts and feeds the carbons, the regulation being current regulation only. This is as it should be, as this lamp is designed for constant-potential work. A screw at the left tightens the spring, and increases the current consumed by the lamp or diminishes it at pleasure. The auxiliary resistance is wound upon an asbestos-covered frame and surrounds the feed-rod channel.

This lamp is intended to burn 125 hours without retrimming. To accomplish this an inner globe is used. The carbon passes through a cover on the top of the globe, which gives a sufficiently tight joint for the purpose, and meets the lower carbon within the globe. Fig. 2 shows the lamp housed for exterior work. In opening for trimming

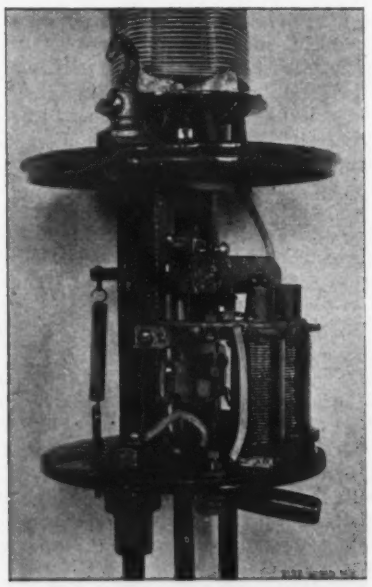


Fig. 1.

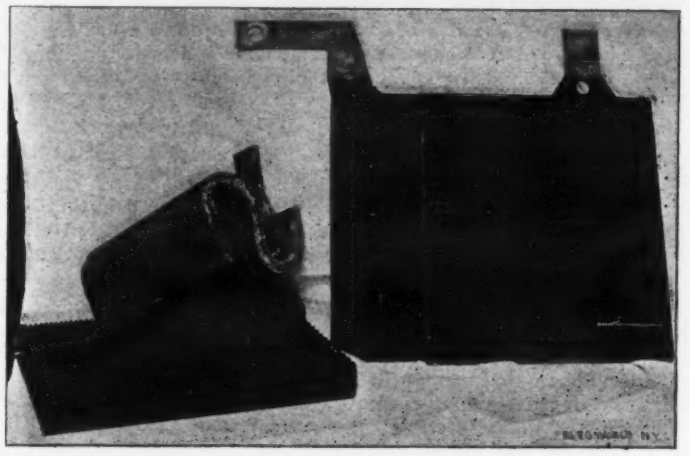
Fig. 2.

the housing slides up, and the globe slides down. It is worthy of further notice that the latter motion is obtained without the long spindle that depends below most all other arc lamps using this motion.

In the manufacture of the lamp Mr. Graves has striven to eliminate expensive processes, but at the same time not at the expense of the working of the lamp. In this he has succeeded to an extent that enables him to offer the lamp at a price that is competitive. The desirable qualities of an enclosed arc lamp are too well known to need mention.

Improved Storage Battery.

The Willard storage battery, made by the Willard Electric & Battery Company, Cleveland, O., is another attempt to solve the great problem of a successful accumulator, and is one that seems to have been eminently successful. The active material is electrolytically deposited by the Planté process, but so modified that the work of forming a plate is a matter of a few hours, rather than days. As no paste is used, any form of plate may be utilized. The Willard Company has chosen for its purpose a modification of the old Brush plate. Instead of being cast, it is rolled out of a single piece of sheet lead. It is deeply grooved on both sides, every fifth rib being much stouter than the others. The grooves are tightly packed with the active material, and so tightly does it adhere,



Improved Storage-Battery Plates.

that the plate may be repeatedly bent backward and forward without injury, as shown in the illustration.

It is said that the plates never buckle, no matter how much current may be drawn from the battery. The plates are incased in hard rubber receptacles, made in one piece. These receptacles are perforated and do not increase the internal resistance of the cell or interfere with the circulation of the electrolyte. They effectually prevent the "sheddings" of the plate from "bridging," or accumulating at the bottom of the cell.

At the right of the illustration are shown two plates, one brand new and the other having been in service for three years, the only perceptible difference between them being the lighter color of the older plate.

The internal resistance of the cell is very low, and is due to the large area of the plates. A plate of linear dimensions of 7 inches x 8 inches has an effective surface of 14 square feet. Moreover, the active material is at no point more than one thirty-second of an inch thick, which is another circumstance conducive to low internal resistance.

The fifth rib is made thicker and the fifth groove wider than the others to allow for expansion. This arrangement also prevents buckling, as the fifth groove is not quite filled with active material.

The life of the plate depends upon its thickness, and the plate can be made in any thickness desired.

The company makes special plates to order without extra charge. The plates are manufactured entirely by machinery, no hand work whatever being used in their production.

Improved Series Arc Lamp.

The needs of series arc lighting require that a lamp feed shall respond instantly to any changes in current, and only an extremely simple and free working feed can do this. Instead of trying new devices the General Electric Company has devoted its attention to perfecting the original clutch type lamp, and has recently introduced several improvements in series lamps of this type. These improvements are shown in the illustrations, and will be found of interest to all concerned in series arc lighting.

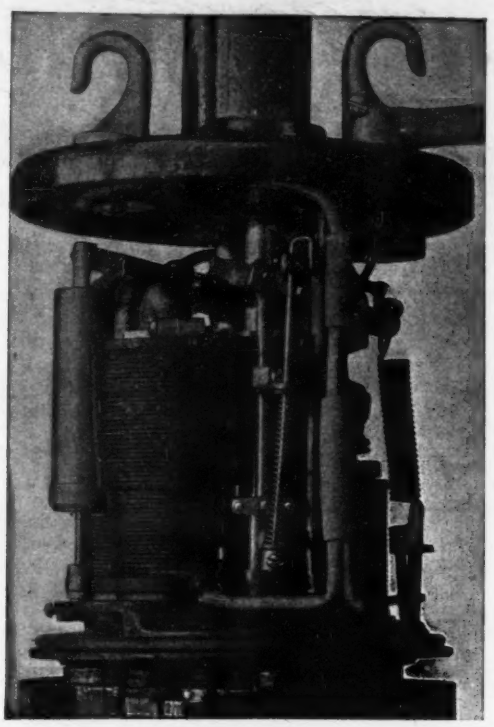
These improved lamps operate on either 6.8 or 9.6 ampere circuits without change in adjustment. That is, the same lamp may be used for 1200 candle-power or 2000 candle-power. This improvement is gained by a special winding on the combination magnets, and an entirely new "bridge contact," which is sensitive and positive in action and free from destructive sparking. It makes the lamp pick up instantly and does away with sputtering and hissing carbons.

The feeding clutch is light, durable, and may be adjusted without removal from the lamp. This is done by means of an adjusting screw, easily reached by a screw-driver and locked by a check nut.

The combination magnets may be removed quickly from the lamp by unscrewing a strap which forms a part of the rocker frame. Other parts of the mechanism need not be removed in the operation.

The lamp is made dust-proof by the enclosing cylinder, which has an internal shoulder fitting snugly against the base plate. The side springs for holding the cylinder in place have been discarded.

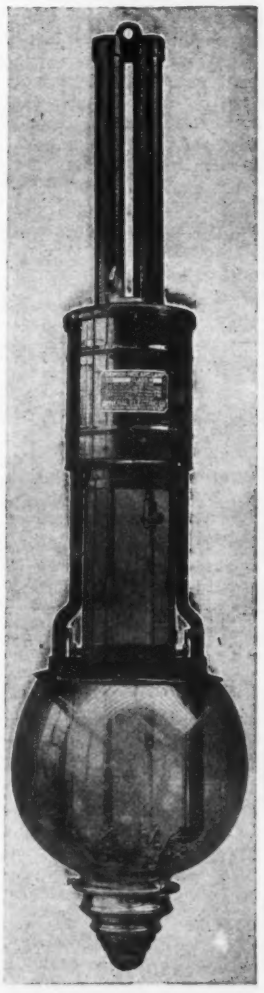
The top of the lamp has been made water-proof by a tightly fitting chimney base.



INTERIOR MECHANISM OF ARC LAMPS.

The lower frame is adapted to an improved globe-lowering device, and the shadows cast by the frame are reduced materially.

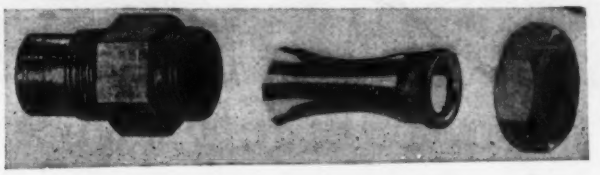
The dust pan has been done away with, and a dust cup takes its place at the lowest point of the globe holder. This catches all dust, and may be removed readily from the lamp.



ARC LAMP.

One of the greatest improvements in these lamps, and one which will appeal strongly to the trimmer and to the one who pays for broken globes, is the globe-lowering device. By means of this the globe is lowered with the greatest ease to a point several inches lower than on earlier styles of lamp, and is held securely in this position while the lamp is being trimmed. In its normal raised position it is held firmly in place by a single latch, which cannot be lifted to release the globe until the globe itself is raised slightly from underneath. This insures a support from below at the time when the latch is withdrawn, and prevents the globes from being accidentally dropped and broken.

No change in the size of carbons has been made, but in the full length double lamp lower carbons may be used, the extra length projecting through the lower carbon holder into the dust cup, from which it is electrically protected by suitable insulation. At the second trimming, these carbons may be raised, and the stubs used for the next run. The weight of the single carbon lamp is 25 pounds, and of the double carbon lamp 30 pounds.



SOME OF THE LAMP PARTS.

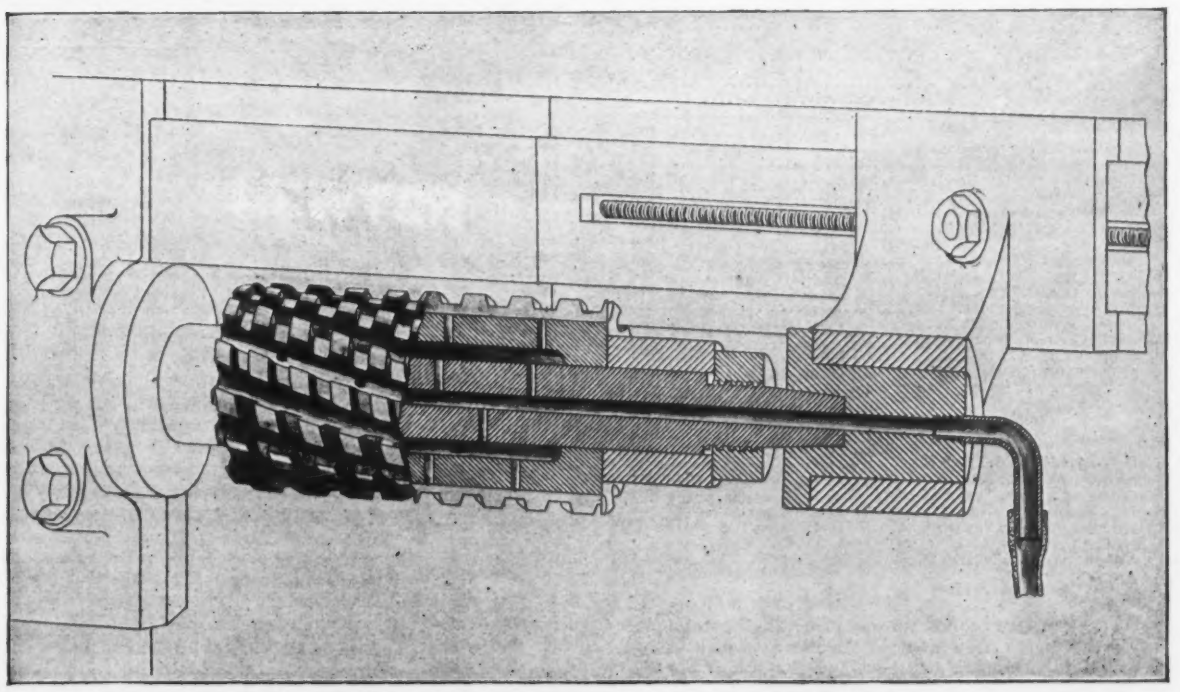
In bringing out these improvements, care has been taken to make each new part interchangeable with the corresponding part of the old lamps of the same make.

These lamps have been designated the new "M" and "K" respectively, and correspond to the former double and single carbon lamps of the company.

Cutter Lubrication.

A new system of lubricating cutters has been introduced by the Newton Machine Tool Works, Philadelphia, Pa. The company has for a long time been carrying on some experiments with the object of devising some method whereby cutters could be run at a high speed and at the same time be kept cool enough to allow for the increased speed. Under the ordinary system of outside lubrication it has been found that the cutter will become gradually heated no matter how well lubricated it may be, and the entire body of the cutter afterward becomes so warm that it is impossible to cool it off. This necessarily limits the speed and the feed of any milling machine. With the new system, however, these objections are overcome by making the arbor hollow and placing a few holes so that the lubricant can pass through the arbor. The cutter is likewise chambered and perforated, allowing the lubricant to be forced through. By means of this system it is claimed that there is no particularly large portion of the cutter that does not have a constant stream of the lubricant passing through it, thus enabling it to be run at a much higher velocity than is usually possible.

Another advantage of this form of cutter is that the risk of hardening is reduced to a minimum, and some very satisfactory results have been obtained in actual use. The company is now utilizing this system on all its new milling machinery, and the system may be used if necessary by passing oil through and out onto the work. The company is, however' using the ordinary lubricant for cast iron, which gives the desired results.



NEW METHOD OF CUTTER LUBRICATION.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, August 8, 1896.

THE GENERAL MARKET.—There was a general falling off in prices in all electrical securities during the past week. All legitimate demand for securities is held in check, and whatever the cause, the condition offers the opportunity for professional operators to attack quotations. The liquidation movement in stocks continued throughout the week, culminating on Friday in demoralization.

ELECTRICS.—General Electric quotations show a net loss of 2¼ on the week's transactions, the highest and lowest points of the week being 24½ and 21⅛, closing at 21¾. Electric Storage Battery suffered a loss of two points or more.

TELEPHONES AND TELEGRAPHS were weak with the rest of the market, American Bell losing four points on the week's trading. Western Union Telegraph on Friday took a sudden drop, the closing quotations showing a net loss of five points.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	..	..
Edison Electric Ill., New York	100	90	93
" " " Brooklyn	100	..	..
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	20	20½
Electric Storage, pref	100	21½	22
General Electric	100	21½	24
General Electric, pref	100	71	73
Westinghouse Consolidated, com	50	24½	26
" " pref	50	49	..

BONDS.

Edison Electric Ill., New York	105	109	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	85	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	105	...
American District Telegraph	100	*20	39
American Telegraph & Cable	100	..	89
Central & South American Telegraph	100	124	127
Commercial Cables	100	125	..
Erie Telephone	100	51¾	56
New England Telephone	100	..	95
Postal Telegraph-Cable	100	70	75
Western Union Telegraph	100	73½	73¾

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	14¾	15
Brooklyn Rapid Transit		18½	20
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	60	65
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	39	43
Hestonville	100	46¾	47¼
" pref		..	62½
New Orleans Traction	100	8	12
" " pref	100	50	60
North Shore Traction	100	15	20
" " pref	100	60	70
Rochester St. Ry	..	15	20
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	61½	..
" " pref	100	85	..
Worcester Traction	100	13	16
" " pref	100	..	90

BONDS.

Brooklyn Rapid Transit 5s, 1945	100	77	..
Buffalo St. Ry. 1st con. 5s	100	..	*104
Cleveland Elec. Ry. 1st mtge 5s	100	100	*103
*Columbus St. Ry. 1st 5s	100	90	*95
Rochester St. Ry. 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge 5s		102½	105
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

TRACTIONS.—Street railway securities showed little more firmness as compared with the week previous, which was probably due to the fact that offerings were very light, and that few actual transactions were made. The general list, however, showed a net loss in prices.

INCREASED ITS CAPITAL.—The Bryant Electric Company, Bridgeport, Conn., has increased its capital stock from $50,000 to $75,000.

QUARTER'S BUSINESS.—The report of the Nassau Electric Railway Company, Brooklyn, for the quarter ending June 30, shows gross earnings, $465,251; operating expenses, $277,449; net earnings, $187,801, other income, $18,925; gross income, $206,726; fixed charges, $184,674; net income from all sources, $22,052; cash on hand, $184,657; profit and loss (surplus), $52,250.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, August 10, 1896.

MR. A. A. DION, general superintendent of the Ottawa Electric Company, Ottawa, Ont., paid THE ELECTRICAL WORLD a pleasant visit a few days ago.

THE STOCKHOLDERS of the Metropolitan Telephone & Telegraph Company held a meeting Aug. 3, and voted to dissolve their corporation. The business of the company has been turned over to the New York Telephone Company. All contracts and accounts for settlement are assumed by the last-named corporation.

THE ELECTROSE MANUFACTURING COMPANY, Brooklyn, N. Y., has just received its medal and diploma of award on its exhibit at the World's Fair. It is remarkable how many applications are found for this company's secret composition and imitation of rubber. It finds great use in the manufacture of electrical specialties.

MR. JAMES E. KEELYN, president of the Western Telephone Construction Company, Chicago, will spend the last two weeks in August in New York arranging some important business extensions of his company. Mr. Keelyn is one of the most enterprising independent telephone men in the United States. He will make the Astor House his headquarters during his stay in New York.

THE C. & C. ELECTRIC COMPANY has decided to expand its business and enter the alternating current field. It will start at once manufacturing alternating-current dynamos and generators, and expects to have 25 and 50-kw sizes ready for delivery for the Fall trade. These will be followed by a 100-kw generator, and in the spring 200 and 400-kw machines will be placed upon the market. After the two first sizes of machines are brought out the C. & C. Company will produce an alternating-current motor, and motors of larger sizes as the business develops. This new alternating-current apparatus will be of the inductor type and of entirely new design. It will possess some commendable features, and is full of promise. Some of the work is already in the pattern shop. The company is also preparing to go more extensively into the manufacture of switchboards. Hitherto these have been made by this company to go with its apparatus, but hereafter they will be so constructed as to be adapted to any type of apparatus. The company will make standard and special switchboards, and with its extensive manufacturing facilities at Garwood, N. J., it is in a position to fill orders promptly. It is the company's purpose to engage in a general electrical manufacturing business and not confine its energies to any one branch.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Aug. 7, 1896.

CLAM BAKE.—Invitations are out for the eighteenth annual Rhode Island clam dinner, tendered to the electrical fraternity by Eugene F. Phillips, president of the American Electrical Works, Providence, R. I. The dinner will take place at Pomham Club on Saturday, Aug. 22 next.

THE MACWATTY & A. C. CROSS COMPANY has recently started in business at 108 Eddy Street, Providence, R. I., where it is prepared to furnish plans and estimates for complete steam and electric lighting and power plants. It is also making mill lighting a special feature. It will handle a full line of electrical supplies.

MR. JAMES BRADLEY, the new manager and treasurer of the Bernstein Electric Company, Boston, is not new as far as service in that company and intimate knowledge of the incandescent lamp business is concerned, a fact amply substantiated by his promotion. Through his active efforts the Bernstein lamps will undoubtedly continue to attract the electrical trade in the way of good orders.

MR. HENRY A. CLARK, Boston, whose name and enterprise stand foremost among the most prominent in the electrical industry, is certainly to be congratulated over his present measure of prosperity, which now exceeds what it has been for three years. The Eastern Electric Cable Company's wire products have always commanded favor, and orders for the Lombard Water Wheel Governor are simply astonishing.

MR. JOHN P. COGHLIN, manager of the Columbia Electric Company, Worcester, Mass., and Miss Josie A. Callahan, of the same city, were united in marriage July 28. Mr. Coghlin is well and favorably known to the electrical fraternity generally, and particularly in Central Massachusetts, and his many friends will wish for him and his happy bride, as we most earnestly do, a life of undisturbed happiness and prosperity.

THE COLBURN ELECTRICAL MANUFACTURING COMPANY'S new building, Fitchburg, Mass., affords abundant room for some years to come in order to take care of the continued and rapid growth of its business. It is a credit to the City of Fitchburg, and it is a handsome monument to the years

of well directed energy given to his business by Mr. Colburn, whose electrical apparatus, as is well known, has gained enviable and widespread reputation for excellence and efficiency.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Aug. 7, 1896.

MR. ELMER A. SPERRY was elected president of the Civil Engineers' Club of Cleveland, O., at its meeting on June 9 last.

UNDERGROUND WIRES.—Mr. T. F. Clohesey, electrical engineer, Cincinnati, O., has completed plans and specifications for an underground cable system for the Cincinnati fire department.

MOTOR CARRIAGES FOR THE ARMY.—Among the bids submitted to the War Department for ordnance supplies, and opened on Aug. 4, was one from the Walker Company, Cleveland, O., for 56, more or less, motor carriages at $8250 per carriage.

THE DAVIS & EGAN MACHINE TOOL COMPANY, Cincinnati, O., at a recent meeting of the Board of Directors, declared a dividend of 3 per cent. out of the earnings for the past three months. The company reports a good business, the July sales being larger than those for any month this year.

ST. PAUL, MINN.—A severe storm passed over this city on the evening of Aug. 3, doing considerable damage to electrical property. The accompanying lightning struck the city electric light circuits and rendered them useless, resulting in darkness in the business section of the city. The telephone lines were also disabled.

STORAGE BATTERY FOR FIRE DEPARTMENT.—The City of Akron, O., has just closed a contract with the Willard Electric & Battery Company, Cleveland, O., for storage batteries to be used in the fire department service. Having tried storage batteries, the city officials are highly pleased with the economic and efficient workings of the same.

THE MONASH-YOUNKER COMPANY, 203 South Canal Street, Chicago, Ill., has lately been incorporated for the manufacture of steam and water specialties. This new company owns and controls all the specialties manufactured by the Van Auken Steam Specialty Company, who will continue to manufacture the same, but whose goods will be sold through the new company.

THE ELECTRIC APPLIANCE COMPANY reports that it was very successful on large deals during the month of July, closing an unusual number of orders for complete electric supply equipments for several good-sized plants. It also states that the general volume of business for the month was reasonably satisfactory, considering the time of the year and the general condition of trade

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, a few months ago presented its patrons with a handsome souvenir in the shape of an inkstand patterned after one of its well-known transformers. On the face of the inkstand was a receptacle for a small monthly calendar. The company has been ever since very courteously supplying these monthly calendars to those possessing these handsome inkstands. The September calendar will be ready for distribution about Aug. 28.

A HANDY SOUVENIR.—The Peru Electric Manufacturing Co., Peru, Ind., is presenting to its customers a neat souvenir inkstand made of electrical porcelain. The well, which represents the stock of a screw, fits into a nickel-plated tripod standard, and the cover, also of porcelain, represents the head of the screw. As the ink test is the usual one applied to electrical porcelain, the Peru company has taken the regular dust to make these inkstands, and their use as inkholders will practically demonstrate the value of this porcelain.

THE CENTRAL ELECTRIC COMPANY, 173 and 175 Adams Street, Chicago, has always made a special effort to secure prompt shipments for its customers. Some time ago the company organized a special department to give this feature careful attention. We cannot go into details of this department work without telling tales out of school; however, we may say that the results are very encouraging; many letters from pleased customers show a lively appreciation of the plan. The Central Electric Company has had a remarkable season for Lundell fans. While the sales in some of the Northern States have been checked by the prevailing cool weather, the southern territory has more than made up the deficiency The sum total of the season's business shows a great increase over last year, this in spite of what some grumblers are pleased to call "hard times."

ENGLISH NOTES.

(From our own correspondent.)

LONDON, July 29, 1896.

ELECTRIC TRACTION.—The Douglas (Isle of Man) Southern Electric Railway was opened last week. The line is 2¾ miles long, and is of an exceedingly trying nature, gradients and sharp curves abounding. The line opens out splendid views of sea coast scenery.

WILLANS' PATENT.—The Judicial Committee of the Privy Council have to-day heard the application for the prolongation of the patent No. 4901, of 1882, granted to Mr. P. W. Willans for the invention of the air cushion used in the Willans high-speed engine. Their lordships were unable to arrive at the conclusion that the said patent had been inadequately rewarded, and recommended that the extension of the patent be not granted.

ELECTRIC LIGHT FATALITY.—A lineman was engaged in inserting a cable in its socket in a transformer sub-station belonging to the City of London Electric Lighting Company when he slipped and fell against the terminal board. As all the live terminals are enclosed, no harm would have been done but for the unfortunate fact that the man had a pair of pliers in his hand at the time and happened to insert these in the porcelain tube protecting the live high-pressure terminal. The coroner's jury returned a verdict of "accidental death," but with the following curious rider: "We think the City of London Electric Lighting Company have not taken proper precautions to prevent their employees meeting with accidents of this character, and *they wish also to express their opinion that the men are not properly paid.*"

MUNICIPAL ELECTRIC LIGHTING LOANS.—Our London parochial authorities are in the habit of borrowing the money required by them for municipal improvements and enterprises from the central authority, the London County Council. As an evidence of the increasing pressure which is being applied to local authorities engaged in electric lighting to set aside adequate sums for depreciation, it may be interesting to notice that in the case of an application recently made by a parochial authority to spread the repayment of a certain electric lighting loan over a period of 42 years, instead of the more usual period of 30 years, the London County Council notified the borrowers that since they had elected to spread the repayment of the loan over so long a term, the Council would decline to sanction any loan to replace plant or machinery bought with the money now lent; it expected the Vestry "to provide for all renewals required during that period out of a sinking fund to be provided for that purpose.

ELECTRICAL "FLOTATIONS."—The mania for company flotation has spread from the cycle to the electrical industry. The well-known Brockie-Pell arc-lamp has just been made the sole basis of a limited liability company, with a capital of £80,000, of which the vendors take £60,000 in cash and shares. The lamp in question is without a doubt an excellent one and it has for this country a good sale; but, for all that, the company would not probably have met with much public support were it not that "money is a drug in the market" To-day yet another well-known electrical concern comes before the investing public. Callender's Bitumen, Telegraph & Waterproof Company, of Frith, proposes to become Callender's Cable & Construction Company, with a share capital of £100,000 and a 4½ per cent. debenture capital of £90,000. The old concern takes the whole of the share capital and £40,000 of the debenture stock, leaving the public to subscribe the modest balance of £50,000, which, I have no doubt, the public will readily do, since 4½ per cent. is difficult to secure in these days, and the business is both sound and long-established. The only curious feature is the complete transformation of a company merely for the purpose of raising £50,000 of 4½ per cent. debentures.

General News.

NEW INCORPORATIONS.

THE COLUMBIA ELECTRIC COMPANY has been organized in Worcester, Mass, with a capital stock of $10,000, by Frank E. Gilbert, John P. Coglin and James J. Rafferty.

THE OLIVE BRANCH ELECTRIC COMPANY, Ferguson, Mo., has been incorporated by George W. Downs, John F. Ashbrook and O. F. Downs, Florisant, Mo. Capital stock, $50,000.

THE BUFFALO, ORCHARD PARK & HAMBURG ELECTRIC RAILWAY COMPANY, Buffalo, N. Y, has been incorporated by M. W. Wheatley, A. W. Hickman, I. W. Allen and U. L. Upson.

THE SAND CREEK & SULPHUR SPRINGS RAILWAY COMPANY has been organized in Jefferson City, Mo., with a capital of $20,000. The incorporators are N. T. White, of Pine Bluff, and others.

TIPPECANOE TELEPHONE COMPANY has been incorporated at Lafayette, Ind.; capital stock, $10,000. Directors, A. D. Pike, Romney; M. P. Gladden, Stockwell; N. I. Throckmorton, Lafayette, Ind.

THE DELTA ELECTRIC POWER COMPANY has been incorporated at Delta, Pa., by S. Morgan Smith, Samuel J. Whiteford, of Slate Hill, Pa., Stephen C. Boyd, of York, Pa. Capital stock, $30,000.

THE GLOBE ELECTRIC HEATING COMPANY, Camden, N. J., has been formed with a capital stock of $100,000. The incorporators are J. C. Haywood, George B. Fraley and Amos B. Paulson, Philadelphia, Pa.

THE CROSSWELL ELECTRIC LIGHT COMPANY, Crosswell, Mich., has been organized with a capital stock of $10,000. Those interested are George W. Sherk, M. L. Sherk and William H. Aitkin, Crosswell, Mich.

THE UNITED TRACTION COMPANY, OF PITTSBURG, has been incorporated at Pittsburg, Pa., with a capital stock of $15,000. Incorporators: John Kolbert, Wm. Francis, Wm. B. Armstrong and Wm. T. Taylor, Pittsburg.

THE MADISON LIGHT & RAILWAY COMPANY has been incorporated at Madison, Ind., with a capital stock of $75,000. The incorporators are: John S. Ward, John E. Sutherland and Lewis J. Highland, Chicago, Ill.

THE RICHLAND COUNTY TELEPHONE COMPANY, Olney, Ill., has been incorporated with a capital stock of $25,000, to operate a telephone exchange in Richland and adjoining counties. The incorporators are Edwin E. Crebs, E. J. Brismalter and C. M. Brock.

ELECTRIC LIGHT AND POWER.

VIRGINIA, ILL.—This town has voted against licensing saloons and appropriating $100 for electric lights.

MINNEAPOLIS, MINN.—The County Commissioners have decided to put in an electric plant at the County Hospital.

MARYSVILLE, TENN.—The Marysville Electric Light & Power Company will purchase a dynamo and electric equipment.

SONOMA, CAL.—The proposition of bonding the town for water and electric light is being considered by the City Trustees.

BEITZHOOVER, PA.—The citizens of this place are discussing the question of establishing an electric light plant in this Borough.

BOWLING GREEN, O.—W. H. Millikin is seeking a franchise to erect poles and string wires to maintain an electric light and power plant.

PHILADELPHIA, PA.—The inmates of the Schuylkill County Almshouse have broken ground for a new electric light plant and hospital.

SEATTLE, WASH.—The Electric Light Committee reported to the Council as to the advisibility of establishing a municipal lighting system.

GLEN ELLEN, CAL.—Dr. A. E. Osborn, in charge of the Glen Ellen Home, proposes to put in a lighting plant to light the buildings with electricity.

GREENSBORO, ALA.—Robert F. Otts is in the market for the purchase of ice and electric machinery, and complete equipment for a cotton seed oil mill.

WHITE HALL, ILL.—A franchise was granted to Henry Rainey and Leo McFarland, by the Council, at their last meeting, for private and commercial lighting.

POTTSVILLE, PA.—A committee has been appointed by the City Council to investigate the advisability of establishing a municipal electric light plant in this city.

WILLIAMSPORT, PA.—The engine of the Citizens' electric light plant in this city was wrecked a few mornings ago by the piston rod pulling out of the cylinder.

MERIDEN, CONN.—The electric light contract will expire in October next, and the old question of municipal ownership of an electric light plant is being revived and discussed.

BANGOR, ME.—The special committee appointed by the City Council for the examination o the street lighting system and its improvement has arranged for the purchase of a new plant.

BEVERLY, MASS.—The Beverly Gas & Electric Company has been awarded the contact for electric lighting. It will furnish 170 arc lights at $140 per lamp and 600 30-cp incandescents at $32.25 each.

MILWAUKEE, WIS.—Thirteen available sites for the new municipal light plant have been offered to the city, at prices ranging from $50,000 to $100,000. It is thought that the prices asked are too high.

UTICA, N. Y.—The Utica Electric Light Company has just received a five-years' contract from the city for electric lighting on the following terms: 34 cents for each arc-light of 2000 candle-power per night and ¾ of a cent per 16 cp-lamp per hour.

Telegraph and Telephone.

COLUMBUS, O.—New bids will be called for furnishing wire for the fire alarm system.

CASCADE, IA.—A telephone exchange is to be established in this place and one in Dyersville.

GRAND RAPIDS, MICH.—The Saugatuck and Ganges telephone line will be extended to Allegan.

ALBANY, N. Y.—A telephone line is to be constructed along the Erie Canal from Albany to Buffalo.

NASHVILLE, TENN.—The new co-operative telephone company is extending its lines to Grand Rapids.

LAUREL, IA.—The question of a new telephone connection with Gilman is now being agitated at Laurel.

ELLENBORO, WIS.—Capt. Beebe will construct a telephone line from this place to Belmont and Platteville.

DELANO, MINN.—A telephone line has just been opened between this place and Watertown, a distance of seven miles.

MANCHESTER, ILL.—The Citizens' Telephone Company will extend its lines to Rood House, Whitehall and Carrollton.

MUSKEGON, MICH.—The new Citizens' Telephone Company expects to open its exchange on Oct. 1 next, with 300 subscribers.

DETROIT, MICH.—The Detroit Telephone Company is now engaged in laying its 60 miles of conduit, which it expects to complete by Sept. 1 next.

GREENVILLE, ILL.—The Central Union Telephone Company is endeavoring to secure enough patronage in this place to warrant its establishing an exchange here.

CARSON CITY, MICH.—The Common Council has granted a franchise to the Crowley Telephone Company, of Middleton, Mich., to construct lines and establish an exchange in this place.

SAN FRANCISCO, CAL.—The Board of Supervisors has recommended that the new telephone franchise be sold under the ordinance submitted by the People's Mutual Telephone Company.

FORT WAYNE, IND.—The School Board has contracted with the Home Telephone & Telegraph Company for 17 telephones, to be placed in the public school buildings and the Public Library.

PHŒNIXVILLE, PA.—The Keystone Telegraph & Telephone Company, recently chartered, has asked the Borough Council of Phœnixville for a franchise to erect its poles and establish offices in the town.

McKEESPORT, PA.—The recent storm was very severe at this place. All of the telephones of the McKeesport Company and some of those of the Bell Company were burned out. The dynamos of the McKeesport Light Company were also burned out, leaving the city in darkness.

KANKAKEE, ILL.—The Central Union Telephone Company has filed a bill for an injunction restraining the city from removing its poles from various streets now being paved. There has been considerable discussion over this question, and this action brings the affair to a crisis.

DES MOINES, IA.—The Mutual Telephone Company has been granted a franchise to operate an exchange in this city. The company must begin work in four months and by June 1, next, must have 500 telephones in operation. The company must also give a bond for $5000, for the proper replacing of street paving torn up for the purpose of laying conduits, and also to protect the city from damage suits.

The Electric Railway.

PROVIDENCE, R. I.—Providence capitalists want to build an electric road to Rocky Point.

THOMPSONVILLE, CONN.—It is now certain that the much-talked-of electric road will be built.

SENECA FALLS, N. Y.—It is understood that work will be commenced at once on the Seneca County Railway.

WEST SENECA, N. Y.—The Woodlawn Beach Railway Company has extended its line from here to Blasdell.

WESTFIELD, PA.—A trolley line from Westfield to Fredonia is projected. Cleveland parties are at the head of the enterprise.

TACOMA, WASH.—Frank C. Ross, of Tacoma, has been granted a franchise to construct an electric road between Tacoma and Seattle.

UNIONVILLE, CONN.—The construction of a trolley road from Suburban station to Collinsville, *via* Sperry Park, is being discussed.

LOCKPORT, N. Y.—The project to build an electric trolley road between Lockport and Rochester, by way of the Ridge road, is again being discussed.

COLLEGEVILLE, PA.—There is talk of continuing the Collegeville and Norristown trolley road from the former place to Phœnixville and Royersford.

WORCESTER, MASS.—A company has been organized to build an electric railway from Worcester to Clinton. The stock has been practically all taken.

MILFORD, MASS.—The people of North Purchase are desirous of having the Milford & Hopedale Street Railway Company extend its rails to Purchase.

BUFFALO, N. Y.—Corporation Counsel Feldman has decided that the Buffalo Railway Company must pave and keep in repair the pavement on each side of its tracks.

NEW HAVEN, CONN.—The Enfield & Longmeadow Electric Railroad Company is to be reorganized in New Haven. The charter for the road has existed for some time, and it is said that capitalists have taken hold of the road and will push it to completion.

HUDSON, MASS.—A new electric railway is to be constructed to connect Hudson, Bolton and Lancaster. A committee composed of Henry Tower, W. H. Moulton and George A. Tripp, of this place and W. N. Felton, of Bolton was appointed. The capital of the company is $100,000.

BELLEVILLE, N. J.—It was decided by the Belleville Township Committee, at a conference held with the Franklin Township Committee, to pass an ordinance enabling the Passaic & Newark Electric Railway Company to lay its rails through Belleville from Joralemon Street and the Northern township line.

THE SCHUYLKILL VALLEY TRACTION COMPANY, Norristown, Pa., has issued a neat little book describing the points of historical interest along the company's lines in the vicinity. It is liberally illustrated with half-tone pictures of many places of historical importance and the descriptive matter is of real interest.

PATCHOGUE, L. I., N.Y.—The directors of the Patchogue & Port Jefferson Traction Company, who want to build a trolley road across Long Island from Patchogue to Port Jefferson, have applied to the Commissioners of Highways of Brookhaven for permission to begin operations, and a hearing will be had at Smith's Hotel, Port Jefferson, Aug. 19.

SCRANTON, PA.—A new order of the Scranton Traction Company requires the conductors to collect for packages carried by persons who ride on the lines of the company. From 5 to 10 cents is charged, according to the size of the package. The order is not received with favor by the traveling public, and the conductors will have much difficulty in enforcing it.

GREENPORT, L. I., N. Y.—The trolley road scheme from Greenport to Orient is again being revived. It is now stated that a syndicate is ready to build the road as soon as the right of way is secured. Road Commissioner E. W. Taber, of Orient, has been requested to secure permits from the property owners along the proposed route. The road will be about eight miles long, and the cost of its construction is estimated at $150,000.

PHILADELPHIA, PA.—A syndicate of Philadelphia capitalists, headed by George S. Gandy, president of the Fairmount Park Transportation Company, and formerly vice-president of the Electric Traction Company, recently acquired control of the New York & Philadelphia Traction Company and the Central Jersey Traction Company, two corporations which have the franchises for the construction of an electric railway between New York and this city.

BROOKLYN, N. Y.—The effect of the decision of Judge Wilmot M. Smith, of the Supreme Court, in granting the injunction of the Brooklyn Elevated Road against the Nassau Electric Railway—unless reversed—will compel the later company to charge a 10-cent fare to Coney Island on all cars which run over the tracks of the old Brooklyn, Bath & West End Railroad. It will also be compelled to stop all such cars at the Union station at Thirty-sixth Street and Fifth Avenue, for at least half a minute, and to notify passengers that they may transfer to the Brooklyn Elevated Road.

Trade and Industrial Notes.

W. E. QUIMBY, 59 Liberty Street, New York, manufacturer of the Quimby screw pump, has just issued a new catalogue of these machines. Copies can be had free on application.

THE JAMES F. BURNS ELECTRICAL WORKS, Schenectady, N. Y., contractors, manufacturers and dealers in all kinds of electrical apparatus and supplies, have issued a complete catalogue of their various products and goods dealt in.

LINE MATERIAL.—Mr. Fred. M. Locke, Victor, N. Y., has just issued cata logue No. 2 of high insulation line material. Mr. Locke makes an indestructible steel insulating pin, and china and glass insulators of standard and special designs for all purposes.

THE CLIMAX MANUFACTURING COMPANY, Corry, Pa., in a pamphlet describes and illustrates the "Climax" high-speed vertical engine. This engine is claimed to be economical, and it possesses some unique patterns in design and construction.

MR. A. O. SCHOONMAKER, 158 William Street, New York, has a large stock of India and amber mica, which he can supply promptly in any form; uncut or block, cut to size or to any pattern. He also carries a large line of mica segments, washers, etc.

THE FERRACUTE MACHINE COMPANY, Bridgeton, N. J., has received from the Columbia Exposition Commission the diploma and medal for its ex hibit at the World's Fair of cutting presses, drawing presses, punching press, etc. The award was given on the boldness and originality in design and perfection of details.

THE WESTERN ELECTRIC COMPANY is placing upon the market some preparations for artificially coloring and frosting incandescent lamp bulbs. The colors are red, green, orange, pink, frost, blue, violet, amber and yellow. These goods afford an excellent substitute for the natural colored glass in all cases where electrical decorations are required and cost is an object.

THE AKRON ELECTRICAL MANUFACTURING COMPANY.—The installation work of this company is eliciting some excellent and favorable testimonials, of which the company is, naturally, very proud. The Diamond Match Company's Barberton, O., plant was installed by the Akron Company, and in a testimonial letter the engineer of the plant speaks in terms of the highest praise of its operation.

THE LAKON COMPANY, Elkhart, Ind., has just completed its new steam plant with which to generate its own current for the testing of its transformers. The plant consists of a 40-hp self-contained, return-flue boiler, built by James Leffel & Co., of Springfield, O., and a 35-hp high-speed engine built by A. L. Ide & Son, of Springfield, Ill. This is evidence of the energy and push with which the business of the Lakon Company is transacted.

Business Notices.

The illustrations in this issue were made by the Photo-Engraving Company 67–71 Park Place, New York.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUG 6, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

564,968. RAIL BOND; F. E. Buxton, Worcester, Mass. App. filed Nov. 29, 1895. The combination of rails having suitable perforations formed therein, bushings within said perforations, a bond wire with terminals diminishing in cross-section, adapted to have bearing within said bushings, and wedges whereby the bushings may be expanded and the bond and rails firmly united.

564,984. DEVICE FOR SUSPENDING AND SUPPORTING TROLLEY WIRES; C. A. Fisk, Washington Court-House, O. App. filed Feb. 23, 1895. In an electric wire supported the combination of two main pieces, a washer and a detachable half held in place by a small projection on the washer.

564,994. SUBWAY FOR ELECTRIC CONDUCTORS; W. H. Hart, Brooklyn, N. Y. App. filed May 20, 1896. In a subway system the combination of upper and lower sections, each having vertical partitions formed in one piece therewith, a horizontal partition having in its upper and lower faces channels or seats for vertical partitions, and a second horizontal partition having vertical partitions in one piece therewith, and extending from one side thereof, and having on its other side seats or channels.

565 032. ELECTRICAL GOVERNOR; M. A. Replogle, Cedar Falls, Ia. App. filed Jan. 26, 1894. In an apparatus for governing power supply, an oscillating lever having extended from its outer end a flexible tongue, said lever and tongue adapted to vibrate between two lines of fixed contact points oppositely arranged in pairs, the said contact points arranged in such position that the lever and tongue aforesaid being pressed toward a line of them will make contact with them in consecutive order, and brake contact in inverse order when pressed away from the same, and said contact points in one line adapted to set into successive and combined action a series of mechanisms for increasing the power supply and the contact points in the opposite line adapted to set into similar action a corresponding series of mechanisms for decreasing the power supply, by means of electric currents and electromagnets.

565,046. TELEPHONE SWITCHBOARD; A. Stromberg and A. Carlson, Chicago, Ill. App. filed Oct. 29, 1895. In a telephone switchboard the combination with a board or standard provided with holes or sockets for the insertion of the connecting plugs, of a pair of springs or contacts on the rear of said board in connection with each of said sockets, a pair of contacts mounted upon the front of the board, and electrically connected one with each of said springs, an operator's telephone set, and means for connecting said telephone set in circuit with the contacts upon the front of the board.

565,053. ELECTRICAL FIRE-ALARM SYSTEM; C. D. Tisdale, Boston, Mass. App. filed Aug. 27, 1895. In an electric fire-alarm, the combination with two wires or conductors, one of which is fusible at low temperature, an insulating material surrounding said fusible wire, the other wire wound on said insulating material, an outer covering of insulating material surrounding the whole, both of said insulating coverings being readily destroyed by heat, one of said wires being connected with one pole of an electric battery and the other wire connected to the other pole thereof and a bell or other sounding device located in the battery circuit.

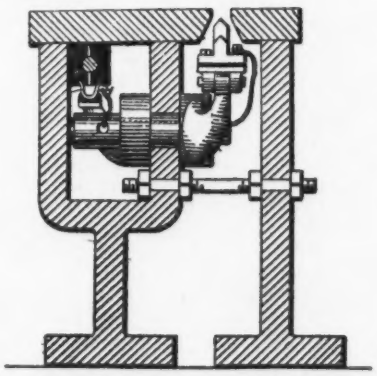
565,056. ELECTRO-THERAPEUTIC APPARATUS; H. E. Waite, New York, N. Y. App. filed April 2, 1894. An electro-therapeutic apparatus comprising a room having a series of rods or uprights arranged about the walls of the room, a series of devices adjustably mounted on the rods and carrying electrodes, and detachable connecting bars for electrically connecting the rods.

565,080. TELEPHONE SUB-STATION APPARATUS; A. de Khotinsky, Boston, Mass. App. filed May 23, 1896. In a telephone station apparatus, the combination with a telephone transmitter, a current-changing signal-sending device, and a source of current supply common to both, of an induction-coil for transforming the currents of said source of supply in both talking and signaling, having different ratios of transformation according as it is operated in association with the transmitter or with the signaling device.

565,085. CONDUIT FOR ELECTRIC RAILWAYS; C. D. Mattison, New York, N. Y. App. filed Feb. 23, 1892. In an electric conduit the combination with the conductor arranged in an air-tight compartment of a trolley rail section arranged in another compartment, a rock-shaft carrying arms which support the trolley rail section, a movable or sliding joint between said section and said arms and a contact arm carrying spring contacts arranged to engage the conductor.

565,086. FIRE-ALARM SIGNAL BOX; G. F. Milliken, Boston, Mass. App. filed April 2, 1891. The combination in an electric signaling apparatus of a signal wheel or circuit-breaker, a non-interference magnet in circuit therewith, a shunt circuit controlled by the said magnet, a second circuit shunting the signaling contacts, and a circuit-breaker therein, adapted to be operated by the actuating train after a predetermined period.

565,092. ELECTROLIER; N. L. Root, C. L. Reed and D. C. Hale, Longmont, Col. App. filed March 13, 1895. In an electrolier, the combination with telescoping, stationary and movable members, of a helical spring connecting said members to form an extensible electrical conductor and adapted to actuate the movable member to return it to its normal position, said helical spring being constructed of bare wire and the insulation of the same being independent thereof.



No. 565,085.—CONDUIT FOR ELECTRIC RAILWAYS.

565,102. ELECTRIC RAILWAY; H. Brandenburg, Chicago, Ill. App. filed May 16, 1895. In an electric railway, the combination of a conduit having a continuously upwardly extending side with a longitudinal groove therein outside of the conduit chamber, of a slot rail overlying the side of the conduit having its rear edge confined in said groove and fastening devices for retaining said slot-rail in place.

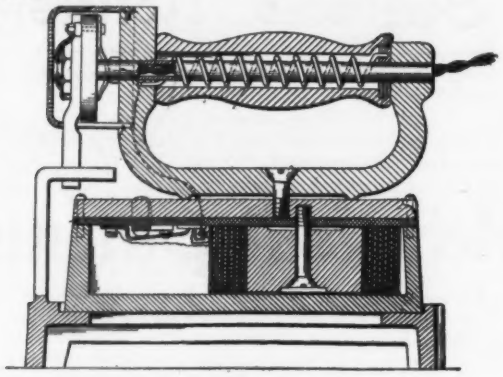
565,103. ELECTRIC RAILWAY; H. Brandenburg, Chicago, Ill. App. filed Aug. 28, 1895. A trolley for electric conduit railways, consisting of a body having joint or flexible end sections and flexible bars centrally secured to said body on each side with contacts carried by said bars.

565,128. COMBINED TYPEWRITER AND TELEGRAPHIC TRANSMITTER; C. E. Yetman, Oak Park, Ill. App filed Sept. 7, 1895. The combination with individual key lifters of a series of upright transmitter switch-shifters corresponding thereto, and actuated in right line movement thereby, mechanical connectors uniting each shifter with its lever and a throw-off common to several connectors, and under the operator's control to cast said connectors in unison, at will, and free the shifters from their key-levers.

565,136. ELECTRIC SAD-IRON; F. H. Date, J. Heffron, D. H. Scranton and J. Scudder, Detroit, Mich. App. filed May 31, 1895. In an electric sad-iron the combination with the body containing a resistance coil having suitable conductors; of a hollow handle, a tube located therein and surrounded with a spiral actuating spring and the switch consisting of a disc located on the

forward end of the tube, a conductor extending through said tube and connected to the contact-springs, and a switch arm having conducting wires leading to the resistance coils whereby the current may be switched on or off of the coils.

565,138. DISTRIBUTION AND REGULATION OF POWER; H. B. Gale, San Francisco, Cal. App. filed June 17, 1895. The combination of a prime mover; its working load; a dynamo-electric machine operatively connected therewith, a system of independently-energized electrical conductors in circuit with the said dynamo-electric machine whereby it is permitted to act interchangebly either as a generator driven by the prime mover and delivering electrical energy to the conducting system, or as an auxiliary motor deriving electrical energy from the system, and a metering device adapted to indicate separately the total energy delivered to the conducting system, and the total energy received therefrom by the said dynamo-electric machine.



No. 565,136.—Electric Sad-Iron.

565,139. METHOD OF AND MEANS FOR ELECTRIC REGULATION OF POWER; H. B. Gale, New York, N. Y. App. filed Jan. 15, 1896. The method of maintaining a substantially uniform load on a prime mover applied to variable work, which method consists in augmenting or opposing the driving effort, as may be required, by the torque of an auxiliary dynamo-electric machine in circuit with an external source of E. M. F. and automatically shifting a controlling mechanism to vary the E. M. F. of the auxiliary dynamo, in response to, and inversely with, slight fluctuations in the load of the prime mover, thereby adjusting the torque of said dynamo so as to compensate for said fluctuations.

565,140. ELECTRODE FOR SECONDARY BATTERIES; G. Hubner, Gernsbach, Germany. App. filed June 24, 1895. The method of constructing plates or electrodes for electric storage batteries, which consists in fusing together nitrated hydrocarbons, mononitrobenzol, or dinitrobenzol or bromonitrotoluol, with nitrated cellulose, mononitrocellulose and cellulose meal and lead oxids and casting the fused mixture to the desired form.

565,150. TRAIN DESPATCHER'S CHART BOARD; J. T. Williams, Brooklyn, N. Y. App. filed April 30, 1896. In a system for indicating the position of trains on a railway, a series of electrical conductors equal in number to the greatest number of trains operating on the road at one time, and extending along the trackway, a miniature trackway having the same number of conductors extending along it and connected respectively with those on the main road, miniature trains running on the miniature road and corresponding respectively to the trains on the regular road, each of said miniature trains being connected with the conductor corresponding to the one with which its corresponding regular train connects, and a series of magnets arranged coextensively with the miniature track, the miniature trains carrying an armature in inductive relation with said magnets and means whereby the regular trains send electric impulses to the magnets, thereby causing the miniature trains to assume positions on the miniature track corresponding to the positions of the respective trains on the regular track.

565,174. TROLLEY WIRE SUPPORT; L. McCarthy, Boston, Mass. App. filed July 20, 1894. A trolley wire support comprising a supporting arm, an insulator, a linked connector extending vertically and intermediate the said insulator and the supporting arc, and another insulator between the said conductor and the said supporting arm, whereby double insulation is obtained between the trolley wire and the supporting arm and the said wire is held by a yielding support.

,178. ELECTRIC CABLE FOR FIRE-ALARM SYSTEMS; H. A. Reed, Newark, N. J. App. filed Dec. 30, 1895. An electric cable or conductor for electric fire or other alarm systems composed as follows: A central wire of fusible metal or compound of metal, an insulating material over said fusible metal, a series of electric wires wound upon the insulating material and an insulating material covering the whole.

565,188. AUTOMATIC ELECTRIC FIRE-ALARM; C. D. Tinsdale, Boston, Mass. App. filed July 11, 1895. An electric cable or conductor composed of two wires, one of which is formed of a metal fusible at a low temperature and covered with an insulating material destructible at a low degree of heat, and the other of said wires being wound about the insulating material on the first wire throughout its length.

565,202. COMBINED TELEPHONE AND DISTRICT ALARM SYSTEM; F. Drake, San Francisco, Cal. App. filed Sept. 26, 1894. In a combined telephone and alarm system, the combination with a telephone line extending from the sub-station to the central station, of a telephone set at the sub-station, a responsive device or indicator at the central station, a switch included in one limb or side of the telephone circuit for opening the circuit through the telephone set, a rotating disc carrying projections or contact terminals arranged at intervals around the periphery of the disc and adapted to successively engage and open the switch as the disc rotates, said contact terminals being electrically connected in pairs, a spring or contact brush adapted to make electrical contact with said contact terminals and adapted to engage one of the contact terminals at the same time that the terminal electrically connected therewith engages the switch controlling the continuity of the circuit through the telephone set, a battery included in circuit between said spring and the second side or limb of the telephone line, whereby the circuit of the battery may be closed over the limbs of the telephone line and through the indicator at the central station, a second spring or contact brush adapted to engage said contact terminals, a protective circuit, and an electromagnet included between said second spring and the second side or limb of the telephone line, a lock for maintaining the disc against rotation, said lock being controlled by said electromagnet, the contact terminals upon which said springs normally rest being electrically connected, whereby the electromagnet, battery and protective circuit are normally included in a local circuit and any disturbance of the protective circuit actuates the electromagnet to release the rotating disc and transmit a signal to the central station.

565,217. CABLE FOR ELECTRIC FIRE-ALARMS; H. A. Reed, New York, N. Y. App. filed April 20, 1896. An electric cable or conductor for electric fire or other alarm systems, composed of a core wire or copper or other electric wire, a fusible metal or compound of metal round about the copper wire, an insulating material over said fusible metal, an electric wire wound upon the insulating material, and an insulating material covering the whole.

565,240. UNDERGROUND TROLLEY SYSTEM; R. E. Sherman and D. E. Kenyon, Chicago, Ill. App. filed Nov. 12, 1895. In an underground trolley system, the combination with a slotted conduit of a housing therein containing longitudinal slotted tubular openings for the outgoing and return conductors of the line, and a bifurcated trolley device comprising conducting arms branching from the trolley pole, and terminating in contacts and straddling said housings to enter said contacts into said tubular openings through their slots from sides of said housing.

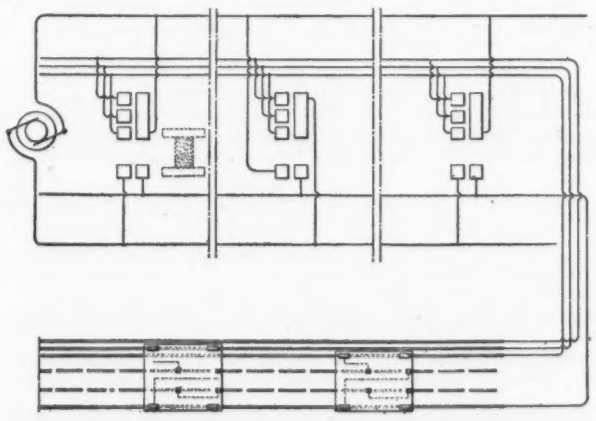
565,244. CIRCUIT-BREAKER; W. B. Tobey and H. W. Smith, Pittsfield, Mass. App. filed Aug. 28, 1895. The combination with spring-actuated shutters having flat surfaces and intermeshing or overlapping parts held normally in contact by the springs and contact plates embedded in the contiguous flat surfaces. of a plate or blade acting as a wedge for forcing apart the shutters when brought into engagement with the contact plates.

565,284. COMPOUND-WOUND POLYPHASE GENERATOR; B. G. Lamme, Pittsburg, Pa. App. filed June 5, 1895. The method of compounding the field of a polyphase alternating-current generator which consists in producing by induction an independent secondary current corresponding to each phase of primary armature-current, combining and rectifying such secondary currents and exciting the field magnet coils therewith.

565,344. CONNECTING DEVICE FOR ELECTRIC CONDUCTORS; H. H. Gilmore, Easton, Mass. App. filed March 7, 1896. In a device for connecting electric conductors, the combination of a body portion, base, hook and spring carried by the base, a rosette, and a blade carried by said rosette to make the shank of the hook a stop for the blade.

565,385. TELEPHONING FROM CARS; M. Carl, Akron. O. App. filed Jan. 10, 1896. The combination of a portable telephone, a portable pole provided with curved arms or hooked outer ends, a box or casing located in the path of circuit between the portable telephone and a fixed telephone, and metallic bars adapted to engage with the hooked ends of the arms connected to the pole.

565,407. ELECTRIC LOCOMOTIVE; R. Eickemeyer, Yonkers, N. Y. App. filed Dec. 30, 1889. In an electric car or locomotive having a storage battery chamber beneath the car-floor and accessible at the end of the car in combination with a battery tray, and rollers for supporting and guiding the tray during its endwise insertions to and its removal from said chamber, said tray being provided with concave roller seats occupied by the rollers when the tray is in proper position.



No. 565,150.—Train Despatcher's Chart Board.

565,410. ELECTRICAL FIRE-ALARM SYSTEM; J. D. Gould, Brooklyn, N. Y. App. filed Aug. 27, 1895. In an electric fire alarm, the combination of two wires arranged close together side by side but not in contact, one of said wires being formed of a metal fusible at low temperature and placed above the other wire and connected at one end to one pole of an electric battery, and the other wire connected at one end to the other pole of the battery, a bell or other sounding device located in the battery-circuit, and a thermostat in electrical connection with said wires.